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THE
ELEMENTS
OF
AGRICULTURE.

BY

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BOOK VII.

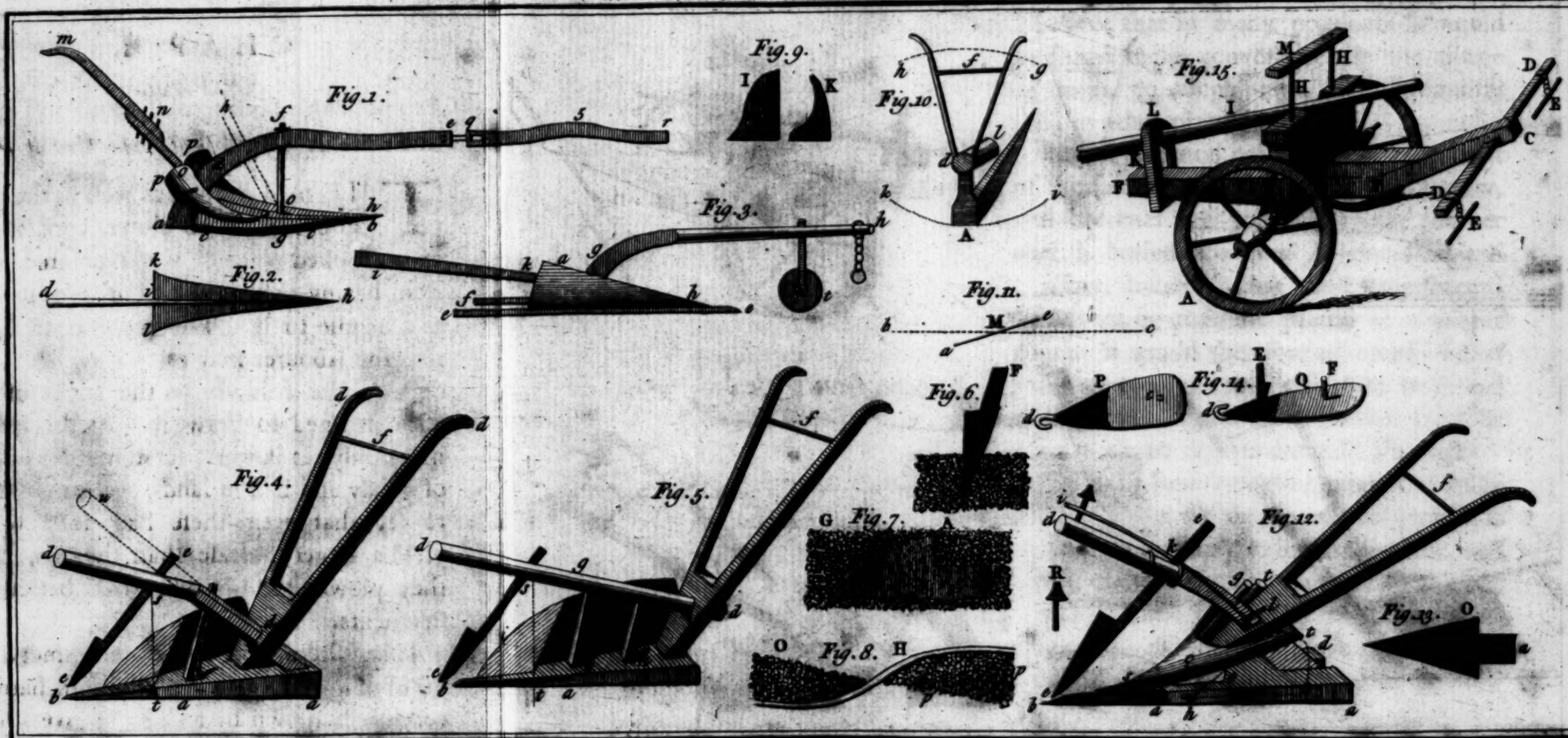
Of the INSTRUMENTS of HUSBANDRY.

THE proper cultivation of lands, particularly in large farms, depends much on the goodness of the instruments made use of. The principal part of the work, in lands intended for the production of grain, is always performed by an implement called a plow. In gardens and small plots the ground is cultivated with the spade, hoe, hook, pick ax, large and small mattock, &c. Each of these instruments has its particular use, on which it is unnecessary to dwell, as we mean only to treat of lands in tillage. The make of the plows used in different provinces varies greatly. I at first imagined, that this variation in the form of instruments of husbandry proceeded from the different nature of the lands, whether strong, light, or stony; but this

does not always appear to be the case; and I believe that in many provinces it would be found more convenient for the tillage of lands, to adopt plows more frequently used in other places.

In the common method of sowing, part of the seed falls on the top of the furrow, and becomes the prey of birds; another part is buried too deep in the land and perishes, insomuch that those only succeed which are by accident placed at a proper depth: it would therefore of course be of great advantage, could this seed be spread with greater regularity; and this may be done with an instrument called a drill.

To bring land into good order, and make furrows proper for the reception of grain, it is sometimes necessary to break the clods, and often, to tear up the roots of pernicious weeds. These works require rollers, harrows, &c. To each of these three articles we shall allot a particular chapter.



AGRICULTURE. 3

CHAP. I.

Of Plows.

SECTION I. *Of the most simple kind of Plow.*

THE most simple, as well as the most imperfect of all plows, consists only of a crooked piece of wood pointed with iron, having behind a kind of lever to serve as a handle to it. This plow is so light, that the labourer may carry it on his shoulders to the field, or on the backs of the asses destined to draw it. As this instrument only, as it were, scratches the surface of sandy and barren lands, we can venture to say that even these bad soils would yield a larger increase than they do, were they plowed deeper and with better instruments.

It is quite unnecessary to recommend the use of this small plow, or of a bush harrow, commonly drawn by an ass, to give a light culture to those seeds lying above ground, when the furrows are at a distance one from the other, after the manner of the fields which in Auvergne they say are sown in alternate furrows.

4 E L E M E N T S o f

SECT. II. *Of the Araire, or small Plow of Provence.*

In Provence, Languedoc, and several other provinces, they make use of a plow called *Araire*, plate 1. fig. 1. which is scarcely more complicated than that we have just mentioned. It consists of a ground wrift, a b, from three to four feet long, ending in a point towards b : the under part of this ground wrift, instead of being flat, is formed into a ridge, which extends the whole length of it.

This ground wrift, at the end a, terminates in a strong tenon fixed in a large mortise, which is at the extremity d of the beam d e, and is besides fastened to the beam by two uprights of iron f g, which have a head at g, and going thro' the beam are keyed at f : the distance between the under part of the beam about f, and the upper part of the ground wrift towards g, is about fifteen inches. Instead of these iron uprights there is sometimes put a piece of sharpened wood or iron, as represented by the pricked line h g, which serves instead of a coulter.

On

Fig. 1.

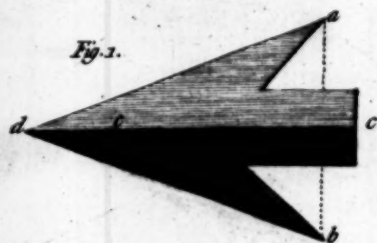


Fig. 2.

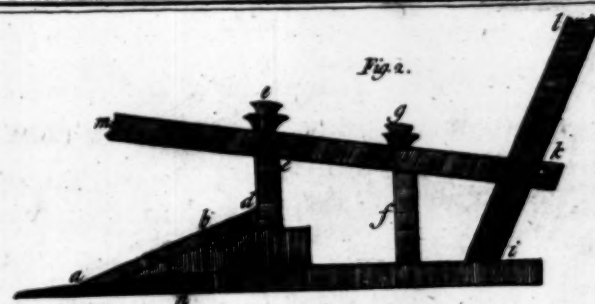


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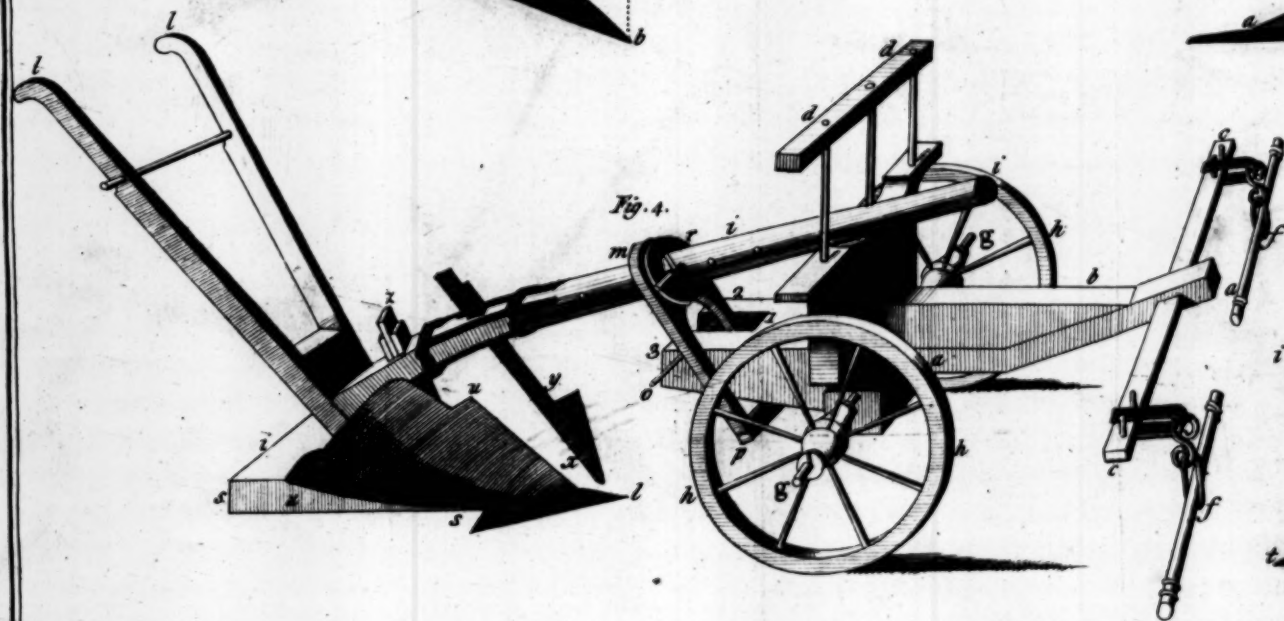
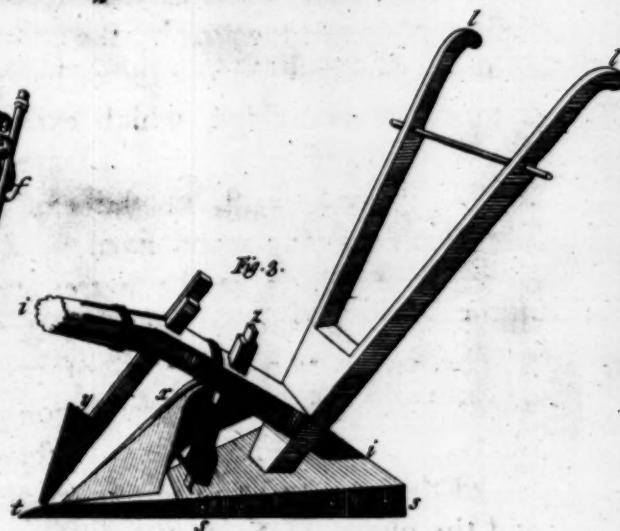
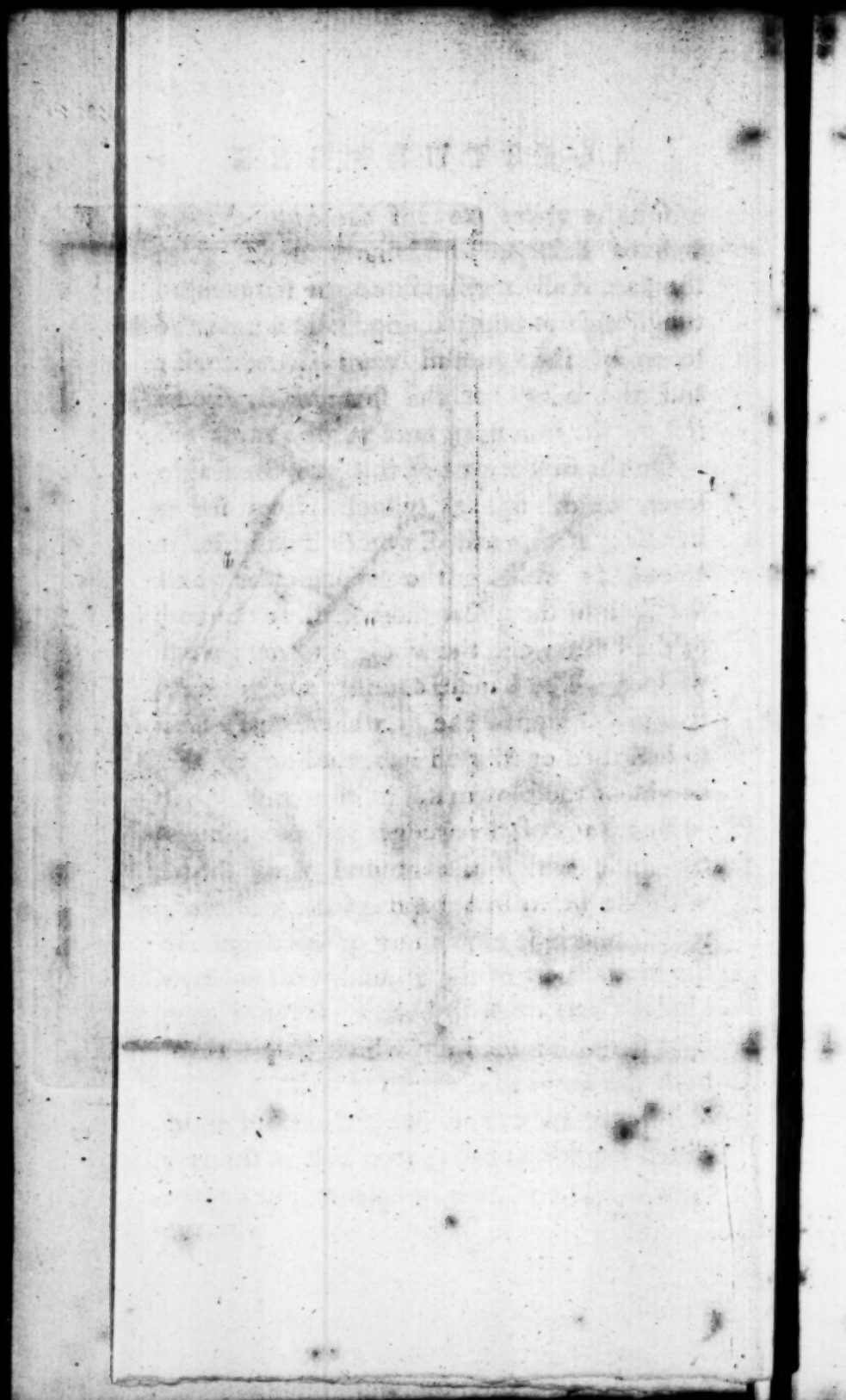


Fig. 3.





A G R I C U L T U R E. 3

On the upper part of the ground wrist is fixed a large iron share, *o d h*, fig. 2: the part *d i* is received into the same mortise of the extremity *d*, fig. 1. in which the tenon of the ground wrist is fastened; and the wings of the share, *k a l*, fig. 2. rest on the iron uprights *f g*, fig. 1. and *o d*.

On the hinder part of this plow is a single lever, *m d*, fig. 1. which serves for a handle: at the end *d*, where it is bent, it enters, as well as the ground wrist and share, into the great mortise *d*, at the end of the beam; and the whole is secured with wedges. The handle consists sometimes of two pieces lapped one over the other at *n*, to lengthen or shorten it according to the height of the plowman. *h i c d l m n w o l q e d i*

By means of the wedges just mentioned, the angle which the ground wrist forms with the beam may be at pleasure altered, which makes it plow more or less deep. At the hinder part of the ground wrist are two kinds of ears or earth boards, fastened at *o* by a strong wooden pin which passes thro' both the ears and the ground wrist. *h i l o w*

The beam *d, f, e*, which is from eight to ten feet long, has an iron bolt at the end *e*, which enters with great ease into a large

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mortise made at the extremity g of the piece of wood g, s, r, intended to pass betwixt the oxen and fasten their harness to. When a single horse is used to this plow, a shaft is substituted instead of the piece of wood g, s, r, and fastened to the end of the beam e by an iron ringlet.'

It is evident that this plow goes a greater or less depth according as the draft is more or less raised. The plowmen, as I have already said, can alter the angle which the ground wrist forms with the beam, by driving the wedges into the mortise of the beam, which receives the end of the ground wrist and handle. But these directors being too little exact, it is necessary that the plowman should lean on the handle m when it cuts too deep, and raise it when it makes too shallow a furrow : this labour is so constant, that were the plow to work in a strong soil, it could not be born. In breaking up lands, they also use in Languedoc, in the earldom and other places, plows very little different from ours. The two little earth boards p p turn over to the right and left the earth that has been loosened by the share ; but this is not done as regularly, as when there is but one earth board,

A G R I C U L T U R E. 7

board, which throws the earth into the furrows before made, as fast as it comes out of that which the plow is forming: it is certain however, that the under part of the ground wrist being ridged, the plowman always rests it on one side, which occasions the greatest part of the earth to be thrown one way.

These plows have no coulter, so that the earth is not at all vertically cut: for we cannot esteem as a coultter either the piece of sharpened wood or sheat that joins the ground wrist to the beam, and which is placed a little before the small iron bars f g. The bar represented by the pricked line h may serve instead of a coultter, but it must then be made of iron; and in this case the coultter would be very improperly situated, for it should by rights be before the share.

These plows are convenient enough to use among trees, or in vineyards, or may serve to stir the ground in the intervals between the rows of Sainfoin or Lucerne: but after all it is rather to be esteemed a cultivator than a real plow, as will appear by what we have farther to say.

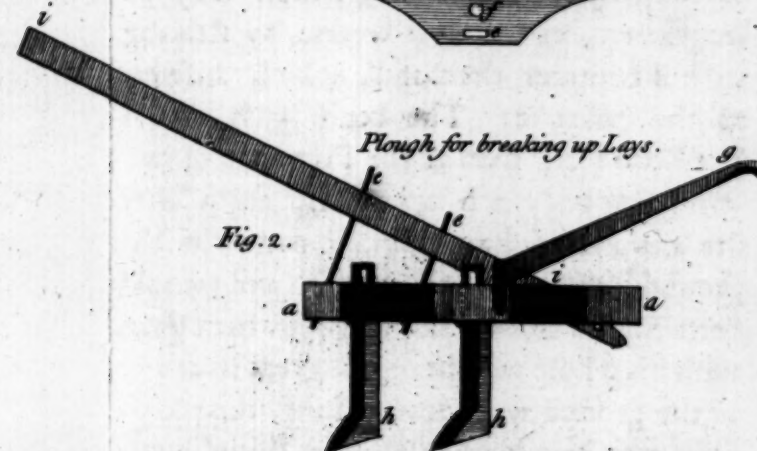
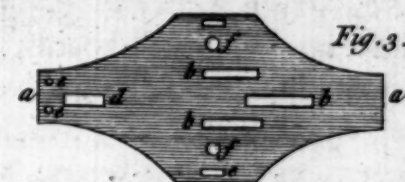
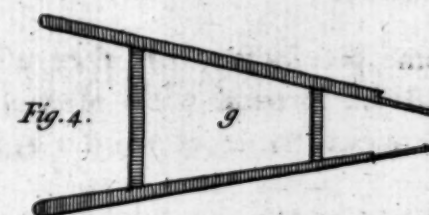
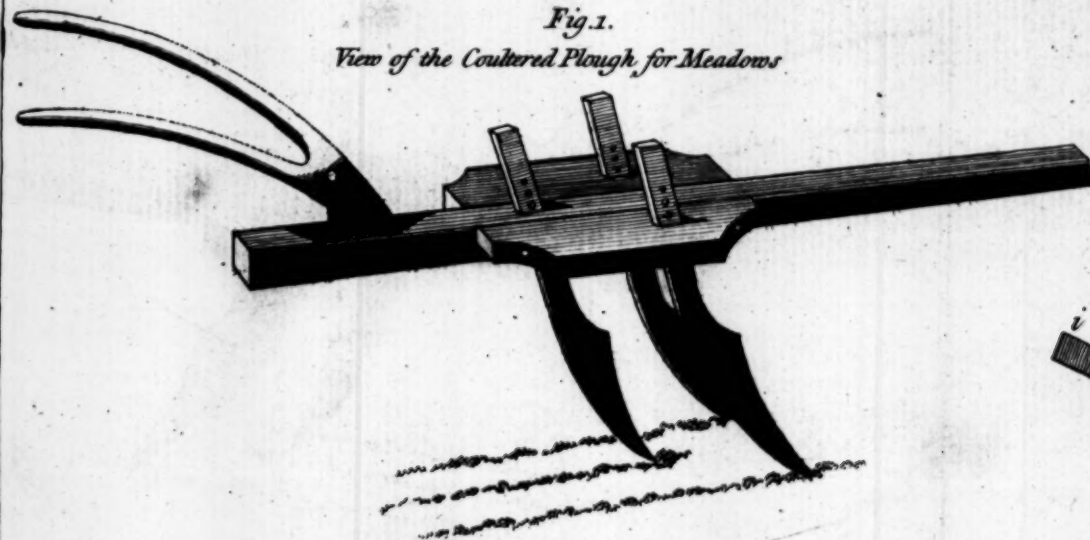
SECT. III. *Of a large Plow used in different Provinces, where they till the Ground with Oxen.*

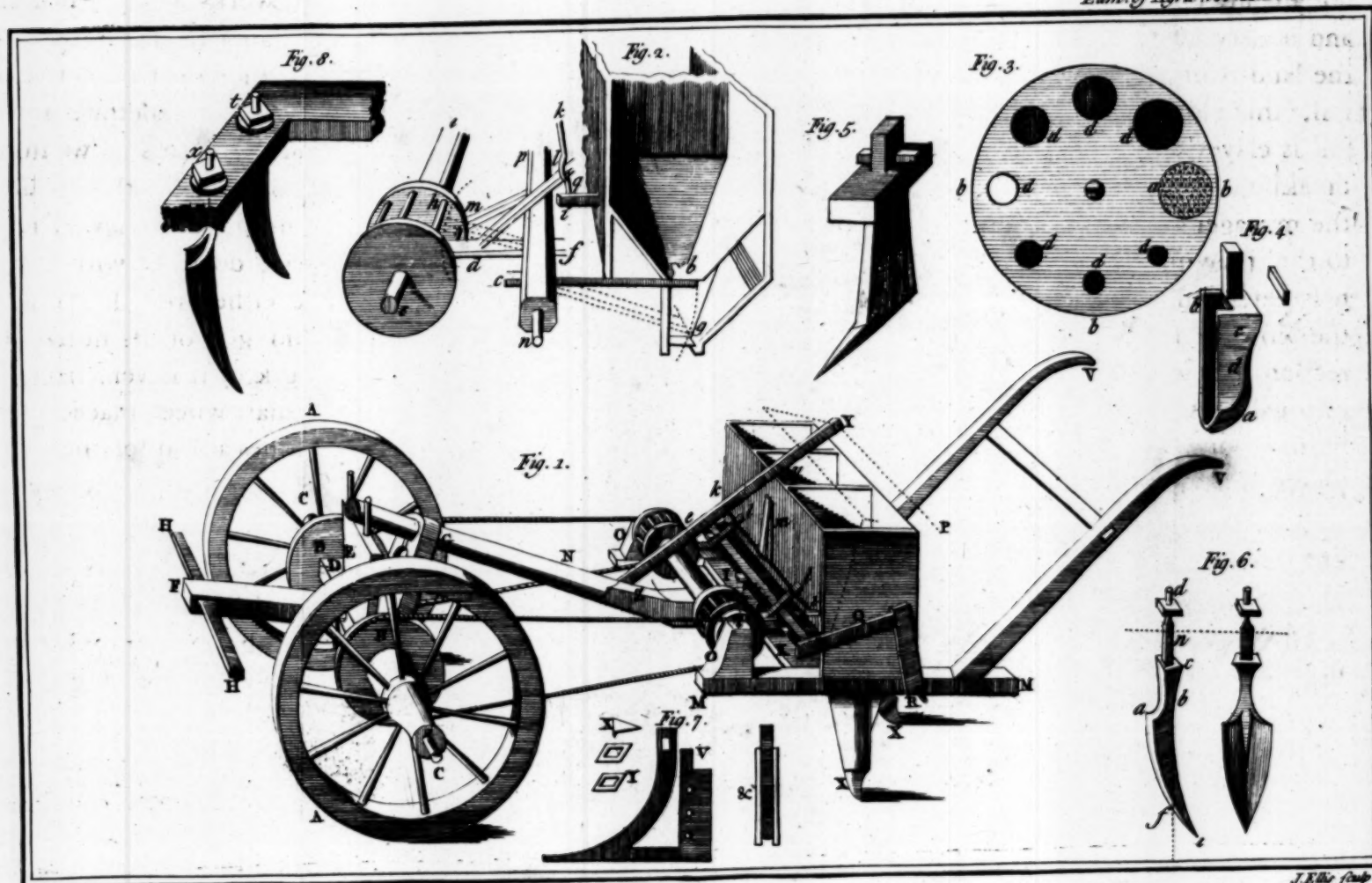
In some provinces where they use oxen, they till the ground with plows, fig. 3. which are only a mass of wood a b, formed by several pieces fixed to the ground wrist c d, which is very long. This mass, which forms two earth boards, with the ground wrist makes a large wedge, terminated by an iron point, which may be lengthened, as fast as it wears, by striking with a hammer the bar f, which answers to the point e. The beam g h differs but little from that of the Provence plow.

As the body a b opens the earth after the manner of a wedge, the part c of the ground wrist inclines to rise, and would certainly do so, did not the plowman lean with his whole weight on the great lever i k: as the ground wrist is very long, the plowman may lean heavily without being in any danger of raising the point of the share out of the ground. This lever i k, not only serves to determine the depth at which the point of the plow shall go, but also to direct the plowman in making straight furrows.

This

*Fig. 1.
View of the Coultured Plough for Meadows*





This plow is the most defective of any I know : as it has neither a cutting share nor a coulter, it works with great difficulty, and is very fatiguing to the cattle. When the land is dry, though it be not a strong soil, this plow cannot penetrate it. If the soil is clayey and wet, this plow, instead of breaking, kneads it. As the great lever, the management of which is very laborious to the plowman, does not with any exactness determine either the depth at which the plow should go, or its horizontal direction, the work of it is very irregular and unequal. A small wheel placed under the beam is sometimes added for the ease of the plowman, but is in truth of little use *.

SECT. IV. *Of good Plows used in several Provinces.*

Good plows should not only penetrate the land to form a furrow, but should also turn

* In the *Angoumois* they make use of a plow which they call *Areau*, very much resembling the *Arare* of *Provence* : it has nevertheless two handles, no coulter, nor share, but a small iron bar fixed between two pieces of iron which widen behind, and an earth board. There are also to be met with in this province plows with wheels before ; but as they have not a cutting share, they cannot be ranked with the good plows.

turn over the earth as it is loosened, and carry it into the furrow that was before made, so that the turf lies at the bottom of the furrow that is to be filled, and the bottom of the furrow that is making forms the top of the other that is filling. To do this work with any degree of exactness, the ground must be vertically cut by a coulter, e e, fig. 4. horizontally underneath, by a sharp share, a b, and turned upside down by the earth board i. The plows we have described are deficient in all these points. Thus, that which I first mentioned can only be of use in sandy and light lands : the other may be of use in very stony grounds, particularly if the stones partake of the nature of flints, or brown free stone, which are very apt to wear the coulters and shares. But the good plows which are in use in many provinces are formed of one piece of wood, a a, fig. 4. and 5. flat at bottom next the ground, and which is called the ground wrist. This ground wrist is in the fore part furnished with a piece of flat iron pointed and cutting, b, called the share. We shall hereafter take notice that this bears several forms. The piece d d, called the beam, and which serves to connect the plow tail with its head,

AGRICULTURE. II

is joined after different methods to the ground wrist, as may be seen by comparing fig. 4. and 5. The part g g is called the sheat, and the part h h the drock. The beam d d receives into a mortise a piece of sharp iron, called a coulter, which is fastened into the beam with wedges. At the back part of the ground wrist are the handles f f, as may be seen by fig. 4. and 5. i is the earth board, which is made of various forms, as shall hereafter be noticed. This short description will suffice to render what I am about to say intelligible.

It is easily conceived that the sharp coulter F, fig. 6. which enters the ground to the depth of about four inches, cuts it vertically: the share A, fig. 7. which immediately follows under ground at the depth of three, four or five inches, cuts a sod of earth or turf G, which being loosened by these two sharp instruments, suffers the earth board which follows, and is in form of a wooden wedge, to raise the turf O, fig. 8. and to turn it into the furrow p, which it ought to fill; so that the grass O lies at the bottom of the furrow p. When the turf is thus turned, the grass is no more to be seen, the loosened earth alone appearing at the
top

top of the balk. There are earth boards, I K, fig. 9. of various forms: some, on being intersected at the line s t, fig. 5. form the ogee I: the form of others, which are made higher, and act by their upper parts, is represented by K: in fine, there are many more which approach either to one or the other of these shapes; and these variations are of so little consequence, that most people keep to the particular sort that is in use in the place they live in. It is sufficient to notice, that when the shares are very broad, it is necessary that the earth boards should be larger than when the shares are narrow. As we have hitherto only mentioned the plow tail, we shall next describe the heads which are put to the plows in most of the provinces of the kingdom: it will then be necessary to point out their particular use.

The plow head is composed first of two small wheels, A A, fig. 15. from 20 to 22 inches diameter. Secondly, a piece of square wood, B, of two inches and a half thick each way, which is called the box. It receives the iron axletree, the ends of which enter into the naves of the wheels: it is let into the under part of the box, which is cased at each

each end with iron, and serves to add strength to the axletree. Thirdly, a piece of wood a little curved, C, called the shaft or pole: it rises a little before, and rests behind on the box: this part serves by way of beam to draw the plow head. Fourthly, this shaft is traversed by a kind of bar, D D, called the cross stave. Fifthly, at the two ends of the cross stave are fastened by small links the spring-tree bars E E. Sixthly, upon the shaft is placed a strong piece of wood F, to which it is fastened by several strong pins. The forcer is inserted on a level with the box, and extends pretty far behind the saddle to receive the lower part of the collar. Seventhly, over the box is placed the saddle G, which consists of several planks, two inches and a half thick, laid one upon the other; the uppermost is a little longer than the rest, and projects: these planks are all secured by two pins, H H, of wood or iron, which passing thro' the whole thickness of the saddle, enter the box. These pins or crow staves are confined a-top by the gallows M, thro' which they pass. Some saddles consist of two crow staves or uprights, fixed in the box, traversed by a pillow on which the beam rests:

rests : I is part of the beam of the plow tail, which rests on the saddle, and is confined by the collar K : this collar goes round the extremity of the forcer. At L may be seen the pin called the regulator, and the ringlets, which make it pierce more or less. The use of the plow head is as follows.

There can be no doubt but that by raising the end d of the beam, fig. 4. and 5. the point b of the share is raised in proportion: this makes the plow bite the less: but in lowering the end d of the beam it also lowers the point b of the share, whilst the part a of the ground wrist rises, and the plow inclines to enter deep into the ground, or, as it is called, pierces or bites much; by which it appears that the position of the beam makes the share bite more or less.

Let us farther suppose that a certain power was applied to the end d of the beam, and that it endeavoured to draw the plow forward: let us then conceive a resistance to be overcome at the end b of the share: it is evident that the extremity d of the beam will incline to sink, whilst the heel of the ground wrist a, will incline to rise: and these effects would of course follow, if the direction of the power applied

at d did not oppose it, and the plowman at the same time with his whole weight lean on the handles to prevent the heel a of the ground wrist from rising.

On this account, in plows that have no heads, they endeavour to raise the draft; and for the ease of the cattle they make the beam very long, and the handles or the lever that supplies the place of them long and substantial, that the plowman who leans on it may have more power to resist the effort which the heel of the ground wrist continually makes to rise: particular care is also taken that the ground wrist of these plows be made very long, that it may more easily keep its station at the bottom of the furrow.

In light lands the plowman makes shift to manage the share; but in strong soils, notwithstanding his continual labour, he cannot master it. If the lever or handles rise too much, the share goes deeper than it ought to do; and if the handles are lowered too much, it goes too shallow: so that as the plowman is obliged incessantly to labour, the share pierces sometimes more, sometimes less, and tills but badly; for according as the share goes deeper or shallower,
the

the earth board turns over more or less earth; and as this is the case, the plowman finds it difficult enough to make a straight furrow.

All these difficulties are easily surmounted by means of a plow head with a saddle, on which the beam may rest; for, as the beam determines the angle which the share and the ground wrist should make with the land, by wedging the beam exactly at such a height upon the saddle as shall be judged convenient, the effort which the beam makes to drop is prevented by the saddle, which is a fixed point: so that the share always pierces just to a proper depth. Is it necessary to plow deep to form the back of a ridge, it is easily done by raising the saddle or the beam upon it; and this is effected by putting the regulator into different holes of the beam; or, if the direction of the share wants very little alteration, it is done by putting some ringlets above the regulator or pin that serves to stop the collar from sliding forward on the beam: this lowers the beam, and makes the share pierce more. Should it be necessary to plow shallow, to form the last furrows of a ridge, by putting ringlets below the re-

gulator the beam is raised on the saddle, the share rises in proportion, and pierces the land less: as soon as this little alteration is made, the plow goes on with its work, continuing to pierce exactly as much as may be judged proper; insomuch, that in our kindly grounds, tho' not light, the plowmen sometimes make pretty long furrows without touching the plow handles. It cannot be denied but that the saddle of the plow head is of great use in regulating its course; nevertheless, in several provinces where plough heads might be serviceable, they have had no thought of using them. It is indeed true, that the wheels might be troublesome in plowing among trees; but these cases do not often occur: and in fact, it would be better to leave the land near the trees without plowing, to be dug with a spade; or it is possible to make the track of the wheels narrower, and plow nearer to the trees, provided care is taken not to close them too much, lest the plow should overturn.

In order more particularly to set forth the advantage of plow heads, I shall remark, that if the plow tail was firmly fixed to the plow head, so that the two parts made but one

piece, it would be difficult to form a straight furrow, and throw up exactly the necessary quantity of soil. With respect to plowing straight, it is evident, that how little soever the plow head should deviate to the right or left, the plow tail, and consequently the ground wrist and share, having the same direction, would slip into the furrow, or pierce the land more than was necessary; and the proper direction could not be resumed without raising the plow handles, and taking the share and ground wrist out of the ground, and afterwards, moving it to the right or left, pierce the land anew in whatever direction was thought proper. But as in the plows that have heads to them, the beam is a piece of wood of a cylindrical form, fastened to the plow head by a collar of wood only, or a ringle of iron which goes round it, the plowman, by inclining the handles to the right or left, can cause the share to change its direction, and pierce the land more or less; and the plow tail keeps in this position, there being a friction of the beam in the collar or ringle that goes round it, as well as on the saddle which supports it: by a very small jerk the plowman can when he pleases change the position

sition of the ground-wrist and share. This mechanism is well adapted; for two causes concur to give the plows with heads this advantage. First, The motion which the plowman causes in the ground wrist A, fig. 10. to incline either to the right or left, proceeding from his action on the handles f, the center of this motion is in the axis of the beam d, which occasions the ground-wrist and share to incline to the side opposite to the motion that is given the handles: if the handles are inclined to the side g, the center of motion being in d, the ground-wrist will be carried to the side k; and a contrary effect will follow, if the handles f are inclined to the side h.

Secondly, It is easily conceived, that if the plowman inclines the handles to the side where the earth board l is placed, as this part widens towards the top, it of course augments the pressure of the earth on that side, and carries the coulter to the side opposite to it, which regulates the quantity of earth to be taken; and the contrary will be the consequence, if he inclines the handles to the side g opposite the earth board, as he will then diminish the pressure

of the earth board, and carry the points of the coulter and share towards the furrow.

This method nevertheless possesses only a certain degree of power, and it would be difficult to guide well a plow originally ill constructed: the ground-wrist should bear with its entire length on the bottom of the furrow; and tho' there is found in the plow, on the side next the earth board, a pressure which the other side has not, yet it should not fall into the furrow M, fig. 11. which it would certainly do, if the share and the coulter represented by the furrows a e, were in the same direction with the pricked line b c, which is the furrow actually forming. It is therefore necessary that the line a e of the ground-wrist should obliquely cut the line b c, and that the point of the share should advance a little into the land, being careful however not to carry this obliquity to excess. A pretty exact angle must therefore be found, which the plow-wrights seldom hit: this occasions the plowman to be sometimes several days setting and unsetting his plow, till at last he finds the proper degree of obliquity, which happily subsists as much as the plow itself. This attention in properly fixing the
the

the share, is of importance only in plows that have earth boards: in the changing-ear plow, fig. 12. it is unnecessary. The coulter only inclines to the right or the left as often as a furrow is begun; and that on account of the smallness of the earth board, and because the share, being of a uniform shape, is more firmly fixed than those of plows that have earth boards.

It should now be admitted that plows with heads, well managed, till the ground with great exactness to any given moderate depth, that the quantity to be cut may with precision be fixed, and the furrows laid straight: and after what we have said above, it is evident that this degree of precision cannot be attained with plows that have no heads.

Some plows with heads * have the beam almost straight and elevated, as represented by the pricked line u d, fig. 4. in this case the saddle of the plow head is raised very high: others have the beam and saddle very low; of these beams some have a curve, d d, and are fastened to the ground-wrist,

C 3 fig.

* Mons. Duhamel's *Charrue a avant train*, is on the same principle as our wheel plow.

fig. 4. others are straight, d d, and almost parallel with the ground wrist, fig. 5.

In several provinces the plow tail is fastened to the plow head by an iron chain, and a ringle thro' which the beam passes; in other parts this is effected by a wooden collar which encompasses the beam, and is fastened to the forcer. In fact, as I have already said, the make of the earth boards and saddle, and the manner of connecting the plow tail with the plow head, vary much. But these plows, which seemingly differ so much in form, all agree in essential points: so that it is best for every one to have those that are most used in the province he lives in, contenting himself with making some slight alterations in the size of the share, and the make of the earth boards, to render them more proper for his purpose; at the same time taking notice that a large share, which advances the work, requires a greater number of horses than one that is narrow, which has the advantage of making a finer tillage.

SECT. V. *Of the shifting-ear Plow.*

I cannot avoid giving the reader an idea of the shifting-ear plow, which is much used in many provinces.

The ground wrist a a, fig. 12. resembles that of the plow with the earth board, fig. 4. The beam d d is also of the same shape, except that these parts are made less substantial, these plows with moveable ears being intended only for fields in good tilth, and are never used for breaking up lands. The sheat g, and the handles f, are also like those of the above mentioned plow. But the share o, instead of having a fin only on one side, as is represented by A G, fig. 7. has two of a uniform shape, fig. 13. and this is very proper, as the earth is sometimes turned over on one side, sometimes on the other. Instead of the earth board i, fig. 4. and 5. there is a forked piece of wood, s, t, t, called the crotch, which rests by its extremity, s, upon the shank of the share a, fig. 13. The hollow part rests on the sheat g, and the two arms of the fork, t t, extend themselves in the air, so that the crotch is supported by two strong pins, c c, which going thro' it, enter the ground wrist. This crotch

serves to turn over the earth that is cut by the coulter and share. The moveable ear or earth board is a triangle of wood, P Q, fig. 14. with a shank terminated by a hook at the end. In the middle is firmly fixed, as may be seen at c, a pin, E, with a rest or heel to it; and farther on, at F, another pin, thick and short. When it is intended to fasten the ear to the left side of the plow, the hook, d, is hooked into the cramp iron, h, of fig. 12; the pin, E, is driven into the hole e of the same figure, up to its heel; and the end of the pin F bears on the end of the handles, or the extremity of the beam, near the point marked, t: the pricked line, h d, gives the outlines of the ear, supposing it fixed in its place.

We have already noticed, that the ground-wrist and share of the shifting-ear plow differ from others, as their form is on each side uniform; therefore taking away the coulter and the ear, it forms a cultivator. But when the ear is on, the point of the coulter must incline to the side opposite to the ear; and as the ear must be shifted from one side to the other every bout, so must the position of the coulter: this is soon done; for, care must be taken that the coulter e e, figure

figure 12. has room sufficient in the mortise of the beam. If the ear is on the left side, the end, l, of the *setter* is put against an iron pin in the beam, to be seen near l; then the middle, k, of the *setter*, passing behind the coulter, e, it is inclined till the end of it, i, is brought over the pin in the beam: the shape of this pin is seen at R. The pressure of the *setter* against the coulter, e keeps it steady enough in the mortise; but as the mortise is wide, it lies diagonally, its point inclining to the side opposite the ear. When the ear is put on the right side, the *setter* must be altered, the point, l, going over an iron pin that is not seen in fig. 12. being on the right side; the middle, k, goes on the left side the coulter; and the end, i, is fixed on the other side of the head pin: by this means the point of the coulter is borne to the side opposite the ear,

SECT. VI. *Of light Plows.*

The new husbandry having obliged us to invent new plows to till the intervals betwixt the rows of wheat, lucerne, pulse, maiz, potatoes, vines, trees in the nursery, &c. and in a word, of all vegetables that can be cultivated

cultivated in this method; I at first caused a small light plow to be made, but without a head or fore-carriage; yet it had shafts, so that the horse's back served by way of saddle to keep the beam at a proper height. As this plow tired the horse much, because the shafts bore very heavy on his back, I caused a single wheel to be added, which served instead of a plow head.

Tho' many people have used this plow with advantage, I must confess it is defective in requiring great skill in the plowman to draw a straight furrow; and this proceeds from the plow head being of a piece with the plow tail; so that when the wheel takes a false direction, the share must of course follow.

I have found the means of making the common plow serve to till the intervals, bringing the beam towards one side of the saddle, by making the track of the wheels narrower, and shortening their naves; by fixing behind the saddle two *forcers*, one on the right side, the other on the left, that the collar may be put on one or the other, according to the side the share is to be carried to.

To

To lessen the interval betwixt the two wheels, and bring them nearer the plow, the box of the axletree is made shorter than the breadth of the saddle, and the naves of the wheels are shortened, particularly on the outside; by which means the track of the plow is much narrower than common: the naves thus shortened are ferriled with iron.

In common plows the *forcer* projects pretty far behind the saddle, to receive the collar, so that the coulter and share are in the middle betwixt the wheels: but as we wanted to carry the share to the right or left, to earth up the rows, or open a furrow near them, I caused the *forcer* to be cut off at six inches distance from the back of the saddle; and on this end caused two cheeks to be grafted, which formed as it were two *forcers*; so that when the share is to be carried to the right side, the collar is to be put on the right *forcer*, which of course moves the beam.

If, on the contrary, the share is to be carried to the left side, the collar is put on the other *forcer*, and the beam is placed on the saddle betwixt the other two pins: by this slight change the point of the share nearly follows the track of the left wheel, so that

by inclining a little the plow handles to the right, the ground may be stirred very near the rows.

No alteration was made in the plow tail, which may either have an earth board or an ear.

In countries where they use a rope or a chain instead of a collar, the share may be carried from one side to the other, according to the place the hook is fixed in, where it is fastened to the saddle. By this alteration the track of the wheels is made narrower, and the naves shortened, particularly on the outside. With this plow, which differs very little from those commonly used, all the stirrings may be given, whilst the corn is not very high: however, but one horse must be used, or if there are two, they must go one before the other. But when the corn is grown too high to admit the use of this plow, the cultivator or horse hoe must be resorted to, which we shall describe after having given the dimensions of the plow we have been speaking of,

SECT. VII. *The Dimensions of the principal Parts of a Plow, that the Alterations to be made in it, to fit it for stirring the Intervals, may more easily be comprehended.*

The shaft, a a, pl. 2. fig. 4. is from the box to its end twenty-five inches six lines long, and three inches square. The cross-stave, c c, is thirty inches long, two inches three lines wide, and one inch and three lines thick. In plowing either with a single horse, or with one before another, instead of the cross-stave, a spring-tree bar is put at the end of the shaft. The spring-tree bars, f, are twenty-one inches long. The forcer, from the foremost end to the edge of the notch that receives the saddle, is sixteen inches and a half, and as much from the notch to the hindermost extremity; its thickness, or horizontal surface, is two inches three lines; and the greatest breadth of the perpendicular surface is three inches nine lines. The two forcers which we put to the plow used for stirring the intervals, have the same dimensions as the common *forcer*.

The box which receives the axletree, in common plows is about ten inches and a half long; we have reduced it to eight inches: it is four inches and a half square.

The

The saddle, c, is twelve inches nine lines high, ten inches and a half wide at, c, and two inches and a half thick. In the plow for stirring the intervals, there are three pins or crow staves instead of two fixed in the saddle.

The diameter of the wheels, h, is twenty-four inches, and the length of the part of the nave next the plow is reduced to two inches.

The collar from p to m is about seventeen inches. The beam, i, is about six feet long, three and three quarters or four inches at the end next the plow handles, and twenty-eight lines diameter where it rests on the saddle.

The plow handles, from the ground wrist to their end, l, are three feet nine inches long, and are fifteen inches asunder at, l: their breadth is three inches, and their thickness one inch and a quarter.

The ground-wrist, s, is from twenty-seven to twenty-eight inches long, taking in the point that goes under the share; its width behind at, c, near the beam, is six inches; its thickness is three inches; and it grows thinner gradually towards the share. The
side

fide of the ground-wrist next the earth-board is covered with an iron plate.

The share, at the part where it receives the ground-wrist, is four inches and a half broad, and eight is its greatest breadth. The angle of the earth-board that is farthest extended is about seven and a half, or eight inches distance from a line that would intersect the plow.

Some of these dimensions being arbitrary, it is imagined what has been said will be sufficient direction for the plow-wrights. If only one horse is used to stir the intervals, the share must be made narrower.

SECT. VIII. *Description of a Cultivator to stir the Intervals.*

This cultivator is seen in plate 2. fig. 2. a i, is the ground-wrist; i l, is a part of the handles; k m, a part of the beam; g f, the drock which serves to connect the beam with the ground-wrist jointly with the sheat e d: a n, the share, is perforated at a, as may be seen at c, fig. 1. to receive the end of a flat piece of iron, a b d: the other end is nailed to the sheat d: this part is called the *safeguard*, and in some measure supplies

plies the place of a coulter. Between the ground-wrist, n i, and the safe guard, a d, a triangular piece of wood, h, is placed, which goes on each side the sheat d, is not wider than the ground-wrist, covers the socket of the share, and rests against the safe guard a d.

Fig. 1. is the share : a b, are its wings : the distance from, a, to, b, is from eight to nine inches : d, is the point of the share, and c, the socket into which the ground-wrist enters.

This cultivator, which is fitted to a plow head, stirs the earth without turning it over. It is very proper for stirring the intervals of lucerne, or other plants. If there is occasion to turn the earth over, a small earth board may be added, and in countries where they use the shifting-ear plow, by taking away the ear, they make a good cultivator.

Some lovers of agriculture proposed making very narrow and light cultivators, to give a slight stirring betwixt rows of wheat that had been sowed at some distance one from the other, as when they sow in alternate furrows, in order to its being hoed in

in spring. I have not yet been informed what success these trials have had.

SECT. IX. *Plows with Coulters, but no Shares.*

M. de Chateaufieux, for breaking up pastures, caused a plow to be made without shares, but with three coulters, to cut the land in stripes. After having passed this plow over a field, a common plow is immediately put into it; and the land, instead of rising in large turfs, is in small clods.

By passing this plow over a mossy field, the moss is killed, and the sweet grass gets a head. See plate 3. fig. 1.

M. de Ville Savin, who had land in Angou, intending to break up some, overgrown with strong heath, told M. de la Levrie that he designed to use this plow: but M. de la Levrie judged that a stronger instrument was necessary for cutting or tearing up the heath roots, this being intended only for breaking up pastures: he therefore caused to be made a model of the plow, represented by pl. 2. fig. 2.

With this plow, drawn by twelve oxen, M. de Ville Savin tore up very large roots

of heath, which were carefully gathered by women. After two cross plowings the land was brought into good tilth with the common plow.

Explanation of the figures, 2, 3, and 4.

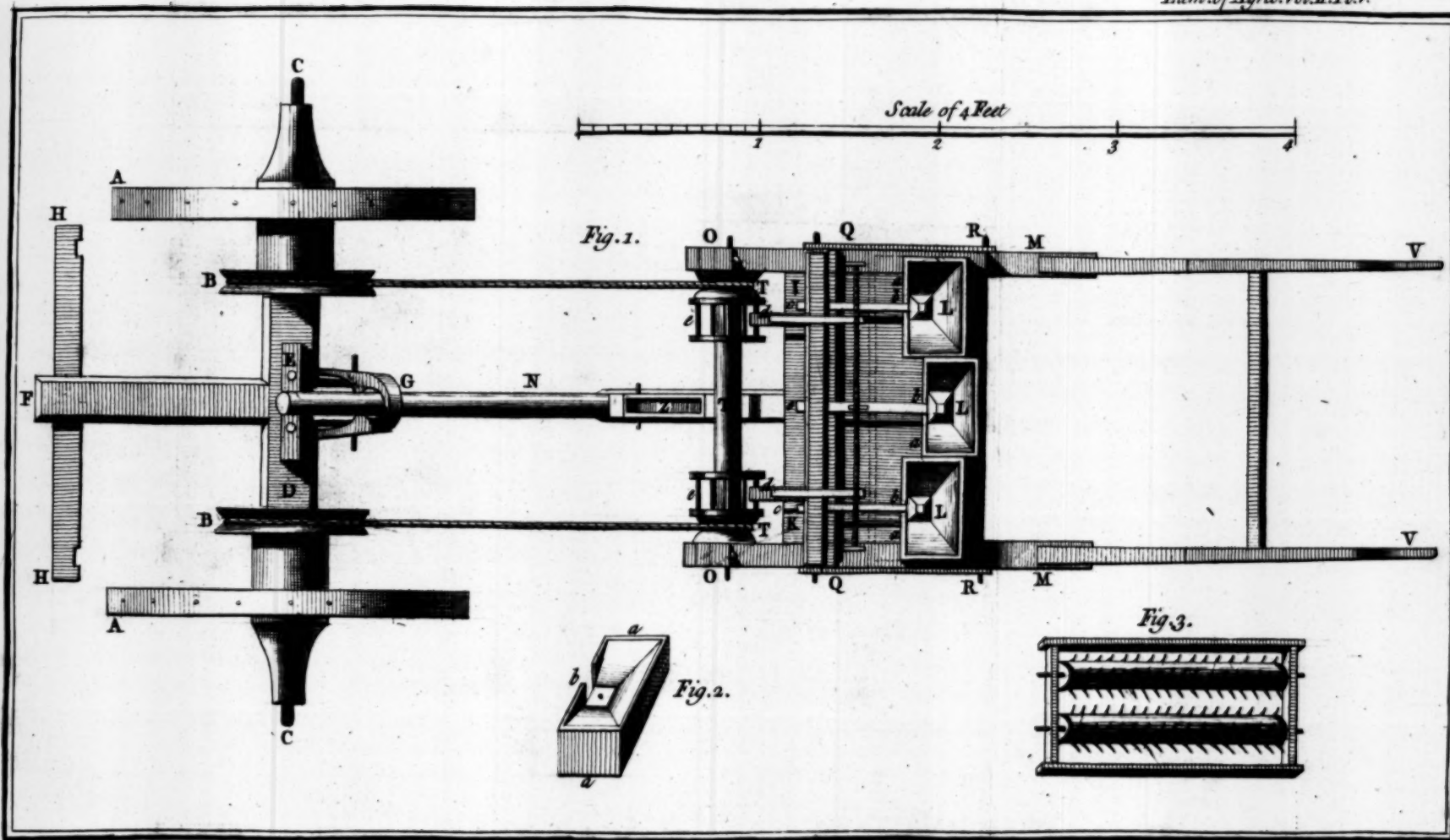
a a, fig. 2. and 3, a plank or table to which all the parts are fixed : b b b, fig. 3. mortises to receive the three coulter : c c, fig. 3. mortises to receive the handles : d, fig. 3. a great mortise into which the end of the beam goes : e e, fig. 3. holes made to receive the iron pins that keep the beam steady : f f, fig. 3. holes in which the iron braces go that should strengthen the handles : g, fig. 2, and 4. the handles : h h, fig. 2. iron coulters : there should be three of them : i, fig. 2. the beam, which is kept steady on the plank by the iron pin, e e, fig. 2.



C H A P. II.

Of Drills.

THE advantages to be derived from an instrument that would regularly scatter the seed have been already mentioned. Husbandmen are very well convinced of



[illegible]

of this, and there cannot be a greater proof of it, than the attempts that have been made to invent new instruments of this kind, or to render those already invented more perfect; every one having principally in view the nature of the soil he cultivated. Thus, some were proper for sowing lands plowed flat or in broad lands, where the corn is harrowed in; others were more particularly adapted for laying the seed at the bottom of the furrow, when the nature of the soil required that it should be sowed under furrow, and the seed covered with the plow.

Amongst these drills of a different construction, some succeeded perfectly well in the hands of the inventors, but they were too complicated and expensive; some parts of them were too fine and delicate to entrust the working of them to a common labourer: such is the drill invented by M. de Chateauvieux, and that of M. de la Tasse. Others, like that of M. l'Abbé Loumille, were well adapted to the method of husbandry practised in the provinces for which the inventors intended them. In each of the six volumes I have published on husbandry, there are several of these drills described,

that every one might adopt that which suited them best, or make those more perfect that merited it, or from one or the other of them contrive something of the same kind, but more perfect and simple. In this work it will be sufficient to mention two kinds, the drill with tongues, and that with a cylinder.

SECT. I. *Description and Use of the Drill with Tongues.*

The description we have given in the last chapter of wheel-plows, will make the description of this drill be much better understood. For the fore-carriage, A A, pl. 4. and 5. fig. 1. is nearly the same as in common plows, and intended for the same use, that is, to keep the end of the beam at a proper height: it has likewise a plow-head, a shaft or pole, a cross stave, a forcer, a box, a saddle, an axletree and two small wheels; all of the same dimensions as in plows, only the box and the axletree are a little lengthened to give it a wider track, that is, to encrease the distance betwixt the wheels: there must also be pullies fixed to the large ends of the naves, as at B, pl. 4. fig. 1.

The

The fore-carriage of a drill has then two small wheels, A A, twenty-four inches diameter: at the biggest end of each nave is firmly fixed a pully, B B, seven or eight inches diameter, reckoning from the bottom of the groove, which is ten or twelve lines wide.

The two wheels, A A, and their pullies, B B, receive the ends of an iron axletree, C C, from twenty-five to thirty inches long, according to the track to be given to the fore-carriage: we shall notice this hereafter. The ends of the axletree are rounded; and the middle of it, which is square, is received into a piece of wood, D, called the box, which supports the saddle, E: this last rises from twelve to thirteen inches above the centre of the axletree.

To the box D are fixed, as we have described in the last chapter, the pole or shaft, F, and the forcer, which extends about a foot behind the saddle, to receive the collar, G. The other end of the pole or shaft is traversed by the cross stave, to which one horse is put: if two are intended to be put abreast, spring-tree bars may be added. Thus, the fore-carriage of a drill differs very little from that of a plow, only that

the track is made wider, and two pullies are fixed to the naves.

The hind part of a drill consists of a plank, I K, nineteen inches long, ten inches wide, and one inch and a half thick.

This plank is perforated in three places, and bears three hoppers, to be seen in pl. 5, fig. 1. at its two ends are jointed two traverses, M M, from thirty to thirty-two inches, one and a half wide, and the same thickness as the plank I K.

In the middle of the length of the plank, the beam N is inserted and secured with strong iron clamps: it passes thro' the collar, G, and rests on the saddle, E. The beam is about three feet and a half long, and only two inches diameter. At the end, opposite to the joints m, are fixed two uprights, Q O, about six inches high, four inches wide, and one inch and a half thick. These uprights bear an axis on which are two trundles, and two pullies, T T, which are less than those fixed to the naves of the wheels of the fore-carriage, being only four inches, or four and a half diameter, reckoning from the bottom of the groove: the trundles are five inches and a half diameter, reckoning from the center of one spindle to the center

center of that opposite to it : and, as they are never to be used both at once, as one is sufficient to make the tongues play, it will be proper, in order to let out more or less feed, to make five spindles to one trundle, and six to the other : these spindles may be made of wood ; but large iron wire is better.

The axis that carries the trundles round is about nineteen inches long : the ends of it are received into a notch made on the inside of the uprights, O, into which they are kept by an iron pin.

The hoppers, L L L, pl. 5, fig. 1. may be seen on a larger scale at figure 2 of the same plate : a a, are little boxes which form the hoppers : the sides must shelve toward the hole at the bottom, that all the seed may be carried towards it : at b, is a groove thro' which the tongues pass. As the hole at the bottom of the hopper does not regulate the passage of the seed, it must be made large enough to let it pass easily.

On the planks I K, pl. 4. fig. 1. is placed the feed-box, PP: this box is nineteen inches long, fourteen inches high, and eight inches wide: it is divided by two vertical partitions, so that there are within-side three compart-

ments, each answering to a hopper: the bottom of each of these compartments forms a kind of hopper, and the sides shelve towards a hole, *b*, which should be six or eight lines diameter: this is seen in figure 2 of plate 4.

On the two ends of this box are firmly fixed two pieces of wood in a square, *Q R*, pl. 4. fig. 1. the vertical angle of the square is fixed by its lower end, *R*, to the joint *M*, by means of an iron pin seen at *R*: the seed-box can thus have the motion of a hinge, which is necessary, as we shall hereafter notice, to incline it backward, to make it scatter more feed.

As to the horizontal angle of this square, it supports a horizontal axis, *K I*, pl. 4. fig. 1. or *n p*, fig. 2. at *n*, fig. 2. is seen one of the ends which goes into the hole marked *n*, fig. 1. in the angle *Q* of the square: it is on this axis that the tongues are fixed, which should have one of their ends on the holes at the bottom of the seed-box, and stop them; for it is only when they are removed, that small portions of seed can drop behind the shares, as we shall hereafter explain.

At *n p*, pl. 4. fig. 2. is seen a part of the axis, *c b*: and one of the tongues which
passes

passes thro' the axis at c, and shuts with its extremity b, the hole at the bottom of the seed-box. To the drill we are describing, there should be three such tongues, marked c b, pl. 5. fig. 1.

Pl. 4. fig. 2. a little *catch*, f d, passes thro' the same axis, n p, one end of which is raised by the spindle h, of a trundle. It is evident, that when this trundle turns, the spindles raise the end d, of the catch d f, as is seen by the pricked line under m. This catch, in rising, causes the axis n p, to turn, and lowers the end b, of the tongue c b, as may be seen by the pricked lines c g; then, the hole at the bottom of the seed-box, being no longer stopped by the tongue, drops a small proportion of seed. But the hole must be instantly stopped; and this is soon done, because the catch d f, and the tongue c b, immediately take their first position. In order to keep these tongues up, there is near the seed-box, and five or six inches higher than the axis, n p, a cord twisted like that on the handle of some saws: a part of it may be seen at k i, fig. 2. thro' this a small piece of wood, l q, passes; and this twisted cord having the effect of a spring, bears the end d, of this
piece

piece of wood on the catch f d, which by this means falls, as soon as one of the spindles is passed, till the end b, of the tongue touches the feed-box.

As the three tongues do not pass thro' the twisted cord that serves as a spring; and, as they are all on the same axis, it is evident, that one trundle is enough to make all the tongues play; however, we put two, one of which has six spindles, the other five; but they are not used together: one of the catches, d f, fig. 2. is taken away from either of the trundles, as more or less seed is to be sowed.

It is evident, that when the end d, of one of the catches goes far into the trundle, it must be raised high to escape the spindle: and the higher it is raised, the more the end b, of the tongue c b, is lowered, consequently, the holes of the seed box remain longer open, and more seed is dropped. Thus, more or less seed may be dropped, first, by using the trundle with six spindles, or that with five; and next, by causing the catch, d f, to enter more or less into the trundle: there are other methods which we shall hereafter mention.

In

In figure 1. plate 4. may be seen the axis, p n, which bears the three tongues and the catches; c c c, the tongues; d, the catches; i k, the twisted cord which forms a spring to press the tongues against the bottom of the box; l l, the little pieces of wood that presses on the catches; m, another piece of wood which serves to strain the cord.

And also in plate 5. fig. 1. may be seen the axis, O O, of the trundles; T T, the pullies; e e, the trundles, one of which has six spindles, the other five: c b, the tongues which pass thro' the axis, to be seen near Q Q: d d, the catches which are raised by the spindles of the trundles. A part only of these catches are seen, because they are partly covered by the pieces of wood inserted in the twisted cord that serves for a spring, and which is seen near Q Q.

It is proper to observe, that every hopper is bordered with a little wooden frame, a a, fig. 2. about five inches high, which forms the tunnel on which the seed-box immediately rests, that the seeds which the tongues cause to rebound may fall into the hoppers: there is, however, in the front of
these

these kind of tunnels a notch, b, fig. 2, which gives the tongues room to play.

The tongues, b b b, pl. 5. fig. 1. with the catches d d, behind the axis thro' which they pass, are from ten to eleven inches long. V V, are the handles: they are thirty inches long, and nineteen a-funder; they either lean on them, or raise them a little to make the shares cut deeper or shallower.

The shares X, plate 4. fig. 1. and 4. are from twelve to thirteen inches in perpendicular height, without the tenons that fasten them to the plank: the width of the side d, is four and a half, or five inches; and their thickness, b c, is two inches, or two and a half: they are made of wood, and hollowed in a groove behind, to convey the seed to the bottom of the furrow that is opening: the part a, which forms an angle, is cas'd with hard iron, more or less strong, according to the stiffness of the land to be sowed; and, by the same rule, the wood of the shares is made thicker or thinner; because too thin a share would penetrate too deep into a light land, and a thick share would not cut deep enough in a strong soil: in this last case it is best to make them

them entirely of iron : they may be made of wood cas'd with iron, as in fig. 5. The first shares I made were entirely of iron, as they appear in fig. 7 ; but I should prefer those represented by fig. six and eight.

I thought it proper to give the form of several, that every one might chuse what best suited his land. But when pointed shares are used, as fig. 5. and 7. it will be necessary to raise the beam more or less on the saddle, to hinder them from cutting too deep : this must not be done by the ringlets that go betwixt the regulator and the collar, for this would alter the distance between the fore-carriage and hind part, and the cords would not be properly stretched ; but a wedge must be used to raise or lower the plank, E, pl. 4. fig. 1. which is the uppermost of the saddle.

It is now easy to conceive that when this instrument is drawn forward, the wheels, A, of the fore-carriage, turn, and give motion to the pullies, B : these, by means of a cord that goes round them, cause the little pullies, T, of the hind part, to turn : as these pullies are on the same axis with the trundles, c c, they cause them also to turn ; and the spindles of the trundles raise the
end,

end, d, of the catches, d f, pl. 4. fig. 2. the end, b, of the tongues, c b, is lowered towards the pricked line, g; the holes at the bottom of the box open, and the seed falls thence through the hoppers, L L L, pl. 5. fig. 1. behind the shares. When the catch, d f, quits a spindle of the trundle, the twisted cord, k i, which with the piece of wood, l d, forms a spring, presses on the end, d, of the catch, d f, and bringing it to its former station, the holes at the bottom of the seed-box are shut.

It is plain, that the seed is thicker sown in proportion as the tongues play quicker: it of course follows, that the land must be sown thicker when the trundle is used that has six spindles than that which has five only. When the horse walks fast, it is best to use this last, that the tongues may have time to resume their places before another spindle puts them in motion. It is also evident, that when the tongues remain long open, more seed is dropped; and the holes at the bottom of the seed-box remain longer open when the catches are so disposed as to take a larger hold of the spindles. We have thus already two means of sowing thicker or thinner. But there
is

is another very simple way. I make the holes at the bottom of the seed-box larger than even large seeds require; but near each hole I fix a round thin plate of copper, b b b b, pl. 4. fig. 3. which turns on the nail, c: in these turning plates are holes of various diameters, d d, &c; so that if you would sow thin, you turn the plate, till the least hole, a, is opposite to the great hole, a b, which is at the bottom of one of the divisions of the seed-box. If too little seed drops, the plate is turned till a large hole is opposite the hole of the seed-box. The same may be done with a copper ruler made to slide in a groove, having in it holes of different sizes, so disposed that there shall always be three holes of the same size opposite the holes of the seed-box: by this simple method the quantity of seed to be sowed is easily regulated. By making oval holes in the plate of copper, oats might perhaps be sowed; but I have not tried it. As in the drill I am treating of, the wheels of the fore-carriage cause the trundles to turn, raising the hind part does not prevent their turning as soon as the drill goes forward, and the seed is wasted. The method of remedying this inconvenience is as follows.

The piece of wood, Y, pl. 4. and 5. fig. 1.
is

is fixed at the lower end, by a pin in the great mortise, Z, of the beam. On the part of this piece of wood which rests on the seed-box is a little iron fork, y, which keeps the box steady on the hoppers, and hinders it from jolting. Now when the dropping of the seed is to be stopped, the workman who is at the handles, V V, raises the piece, Y; and drawing the box towards him, brings it to the position pointed out by the pricked lines of fig. 1. pl. 4; he then lets the piece, Y, fall, the fork of which prevents the box from resuming its first position: then, tho' the trundles turn, the catches, f d, fig. 2. are not in contact with them, and the tongues continue close to the bottom of the box. When you would begin to sow, raising the piece, Y, brings the seed-box into its place. Thus is this matter effected by a single motion of the hand.

Another difficulty was to contrive that the cords which communicated the motion of the pullies, B, of the fore-carriage, to the pullies, O, of the hind part, should have neither too much nor too little tension, in a damp or dry air. This was effected by taking away the pin, G, of the regulator, that the hind part might be no longer
drawn

drawn by the beam, which in this drill is only of use to keep the plank, or table of the hind part in a position nearly horizontal; thus, the hind part being drawn by the cords alone, the resistance of the shares give these cords a proper tension; yet if pointed shares were used the stretching of the cords might make the shares bite too much, but this is easily remedied by raising the fiddle, as we have already directed.

If a field is to be sown in full furrows with this instrument, supposing the interval from the fellies of one wheel to the fellies of the other, to be twenty-one inches, that the rows may be at equal distances, one of the wheels of the drill must be put at its return into the track it had before made; in this case there should be only thirteen or fourteen inches interval betwixt the pullies, B B; by this disposition of the shares the rows will be set out at seven inches distance over the whole field.

And to prevent the shares being choaked up, when there are stones or clods in the field, they should not be placed in a line, but the middle share should be more forward than the others. The difference how-

ever should not be great, and in light sandy lands they are best fixed in a line.

Some drills have been made with moveable shares, whereby the distance betwixt them might be increased from six to eight inches : to effect this the mortise into which the tenon of the shares enters is made two or three inches wide ; and the shares are fixed with a wedge ; and that the seed may always fall behind the shares, the groove that receives it is widened a top. I shall enlarge no more on these minute particulars, as they may be varied at pleasure.

In loose soils and a dry seed time, the earth falls of itself behind the shares and covers the seed ; but if the seed remains uncovered, a kind of raker on two shafts is fixed behind the shares, as in the cylinder drill, and that will be sufficient to cover and bury the seed.

Many husbandmen who have used the drill I have been describing, have observed that it drops less seed when the partitions are quite full, than when they are only half full.

As a remedy for this defect, *M. de Villiers-en-Lieu*, thought of placing on little brackets at a third part of the height of each

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BY [illegible]

IN [illegible]

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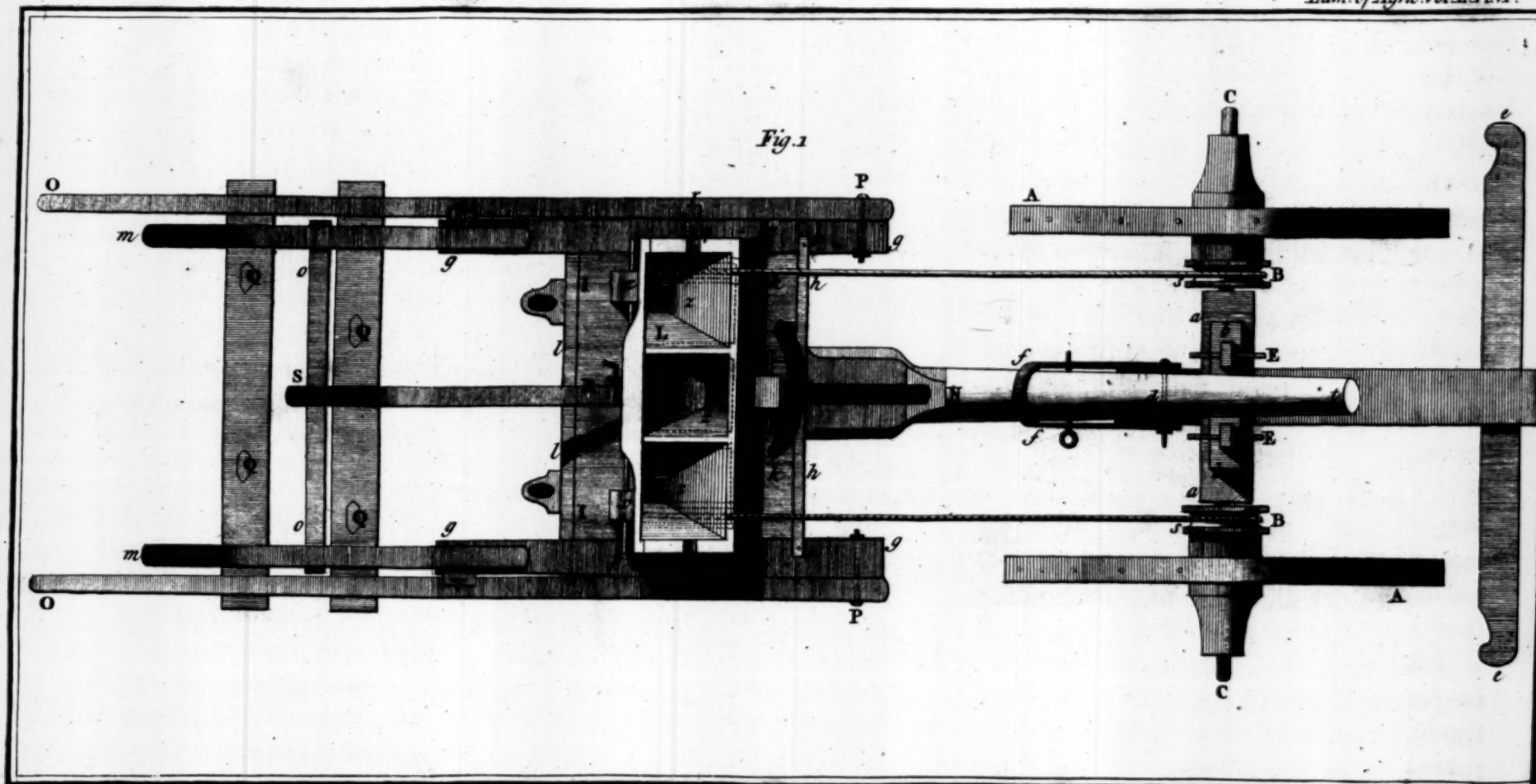
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each partition of the seed box, a thin board a little rising on the upper side, and of such dimensions as to touch the sides all round within an inch : this kind of false bottom supports part of the weight of the seed ; by this addition the seed drops with regularity, whether the box be full or half empty. A horse or two asses will draw this plow.

SECT. II. *The Cylinder Drill.*

M. de Chateauxvieux's drill which I have described in my treatise of Husbandry, having no other defect but that of being of too high price for ordinary farmers, *M. de la Levrie* endeavoured to make it more simple, and of a more moderate price : he succeeded : and *Jouvet*, *M. de la Levrie's* joiner, has rendered it still more simple : it is in this state I am about to describe it.

This drill is represented by the plates, six and seven, fig. 1. 2, 3, 4, 5, &c. In figure 2, pl. 7. the shares are sunk two inches into the earth, to shew the drill as it works.

This drill consists of a fore-carriage and hind part. The fore-carriage nearly resembles that of common plows, but is

much lighter; it is composed of a box, a, fig. 1. and 2. about fourteen inches long, three inches thick, and five inches high, but reduced at the ends and brought to two inches to receive the light ferrils, that keep the axletree in its bed.

On the eight inches in the middle which remain at the full height, by two tenons is fixed the saddle which is a plank, b, fig. 1. and 2. about eight inches high, from fifteen to eighteen lines thick, six inches wide at bottom reduced to four towards the top, where it is hallowed in the middle to the depth of four or five inches; this is rounded at bottom to receive the beam.

In the middle of the box is a mortise which goes thro' it, and serves for the insertion of the shaft or pole, and the forcer made of two separate pieces.

The shaft, c, and the forcer, d, may be made of one piece of wood, two feet, eight or nine inches long, three inches high, and two inches thick; the part extending about eight inches behind the box, is the forcer.

The cross-stave, e, fig. 1. and 2. is as common. The wheels consist of a nave, six fellies and six spokes, and are two feet
four

four inches diameter; they must be made as light as possible; the proportions may be taken from the plate. The wheels may be lightly shod with iron, one and a half line thick, to strengthen the fellies and keep them circular.

The naves are four or five inches diameter in the middle of their length which is eleven inches: they are less as usual towards the ends; at two inches distance from the larger end is a flat whereon to fix the pullies, s, which are eighteen lines thick. When the wheels are on, the middle of these pullies should be sixteen inches and a half one from the other.

These pullies are eight inches diameter from the bottom of their groove, which is ten lines wide. Whether they are round for cords or square for leather straps, they must be made exactly of a size.

The middle of the axletree is a bar of iron one inch square, it is rounded at the ends; the middle is let into the box, where it is kept fast by the ferrils already mentioned.

The hind part consists of two shafts, g g, fig. 1. three feet long, two inches wide, and one inch and a half thick. They are

joined at an inch from the foremost ends by a traverse or cross bar, h, laid on the shafts, with a shoulder lapping over one inch and a half fastened with two little screws. This cross bar is one inch and a half square, and arched in the middle to receive the beam which rests on it.

At ten inches from the fore part the shafts are also joined by means of two tenons, and a tongue by a table ten inches wide, and fifteen lines thick, k, fig. 1. and a foot from the hind part these shafts are also united by a cross bar, l, fig. 1. eighteen lines wide and fifteen lines thick, which serves as a rest for the hind part of the seed box, and to it is fixed the fork that keeps the box steady in sowing, and keeps it raised when you would have less seed dropped : this cross bar and the table are levelled with the bottom of the shafts.

Behind this cross bar and as near it as the obliquity of the mortises will permit, are fixed the handles m, nearly of the length, and in the slope described on figure 2 ; they are supported at the end of the cross bar by the jamb, n, fig. 2. and joined together by the traverse or cross bar, o o, fig. 1.

The

The interval betwixt the shafts is twenty-one inches; so that the hind part of the drill is two feet wide from out to out.

Towards the fore part are two uprights, p, fig. 1. which bear the back pullies; the middle of these uprights are eleven or twelve inches from the end of the shafts, they are four inches wide at bottom, and two and a half or three inches towards the top; they are five inches and a half high, and twelve or fifteen lines thick.

These uprights have on the top a notch, g, an inch deep, and four or five lines wide, in which turn the iron trunnions of the same size as the wooden axletree, r, fi. 1. and 5. reduced to two inches diameter in the places marked, r: the same axletree bears the axes, q, the parts, r, the back pullies, s, and the cylinders, t u, fig. 5.

These back pullies should be four inches diameter from the bottom of the groove, which is ten lines wide; the cheeks of these pullies are eight lines deep; they must of course be placed at the same distance from each other as those in the fore-carriage.

The shares, u u, fig. 2. are two inches thick, five inches and a half wide next the upper part of the table, comprehending ten

or eleven lines, being the depth of the groove, which forms the channel marked with the pricked line, u, and five lines for the thickness of the plank which covers it: the points of these shares incline backward: on raising a perpendicular from their point to the under part of the table, it should be twelve inches, and from this perpendicular to the point where the pricked line, u, is in contact with the table, is four inches.

The front of these shares is chamfered on the sides; it begins three or four inches from the under part of the table, and forms a rectangular ridge; this ridge is covered from the point to six inches high with a piece of iron hammered and steeled two or three lines thick, the edges of which being filed thin are lapped one over the other: this casing is secured on each side with four wood screws with flat plated heads.

The groove is open and hallowed behind from three and a half or four inches high to the point; as it appears in fig. 2.

The tenons, x x, fig. 1. and 2. by which the shares are fixed to the table, are within half an inch of the front of the shares; by which means there is shoulder
enough

enough on that side where there is no great stress; these tenons are three and a half long of which two and a half appear above the table; they are eighteen square, and are fastened by iron keys, on iron plates two lines thick; the key of the middle share goes lengthways of the table the other two cross-ways.

The two pricked lines, u, fig. 2. shew the width of the channel which is ten lines every way: this channel should answer to the apertures in the table to communicate with the hoppers under the cylinder.

These shares, which are exactly like those of the drill with tongues, may do very well in deep plowed kindly soils; but in hard soils, shares like those of *M. de Chateauvieux's* drill must be used, see plate 4. fig. 6. the same may be said of the drill with tongues.

The hind part of this drill terminates before in the beam, t, fig. 1. and 2. made of a single piece of wood three feet, three or four inches long, two inches and a half square for fourteen inches length from the bottom, and from thence to the end it is rounded and reduced to two inches diameter.

The

The beam is fastened to the table by an iron pin, and a nut screwed on it: it rests on the cross bar, h h, fig. 1. where it is also fastened with a nut screw; it is connected with the fore-carriage by the collar, f f, fig. 1. and 2. this collar is either of iron or wood, but has not the pin called the regulator; because the draft is not by the beam, but by the cords or thongs which go from the fore to the back pullies: the fore part of the beam rests on the saddle, b, fig. 2.

Over the table are fixed the hoppers, z, fig. 1. and 2. in such a manner that their apertures answer to the channels, u, behind the shares, that the seed dropping thro' the hoppers may fall into the little furrows as fast as they are made. It is proper to observe here, that the hoppers are not fixed to the table, but to a board over the table, which slides in a groove on each side: it will in due time be made appear in what manner the seed box, the cylinder and all its appurtenances are pushed forward by means of this board when one would cease sowing.

The seed box, A, of which a transverse section may be seen, fig. 2. an oblique section,

section, fig. 3. and which at fig. 4. is intersected at the back, is made of boards four or five lines thick : it is about fourteen or fifteen inches high, twenty-one inches wide ; see E E, fig. 4 ; it is made in such a manner that the bottom, B, fig. 2. 3. being sloped, may be exactly fitted to the cylinders, t u, fig. 3. and 5. The partitions to be seen over the letter, C, fig. 4. are so many small pieces of wood fixed to the back part, DD, of the box ; they have circular notches in them, so that they exactly fit the circumference of the cylinder, without bearing on it in any part whilst it turns. By turning the cylinder end for end, either the large cells, t, or the small cells, u, may be brought betwixt the cheeks or partitions, C.

Let us now observe the manner in which this machine works. The cover, E, fig. 2. of the box, A, is raised, to fill it with seed by the aperture, F. This seed falls on the inclined plane, G, and goes thro' the aperture, H, to the angle, B ; where it is retained by the board, B, (which is the same as, C, fig. 4. and by the circumference of the cylinder : it is on this account that

I directed that board, C, as well as the cheeks or partitions, should be exactly joined with the cylinders, t u, fig. 5. When the cylinder turns, the hollow cells on its circumference are filled with the seed that is betwixt the checks, and drop it towards, I, fig. 2. whence it falls by the inclined plane, L, thro' the channel, u, fig. 2. which is behind the shares, into the bottom of the furrow as it is formed.

Figure six shews the hoppers, z, which are placed over the table, (of which the inclined plane, L, fig. 2. is one of the sides) to answer to the three shares which are fixed under it: the middle share is forwarder than the other two. It is necessary the apertures, y, of the hoppers, fig. 6. should answer those of the shares, that the seed may drop thro' the channels, u, fig. 2.

The seed box may be inclined forward, as appears by the pricked lines, M, and kept to any degree of inclination by means of the piece of iron, N, fig. 2. so that more or less seed may be dropped; for it is evident, that the more inclined the box is the less seed drops.

O P, fig. 2. is a harrow which serves to cover the seed when the teeth, Q Q, are suffered

suffered to touch the ground, as is seen by the pricked lines, q q. In carrying the hind part of the drill, it is much easier raised by the ends of the harrow, O, than by the handles, m; for the harrow moves on iron pins, P P, fig. 1. and is kept from rising by the brackets, V V, which are at the back part of the shafts, g g.

The hoppers, z. fig. 6. are not fixed to the table, but are received in two grooves which makes them easily pushed forward together with the back pullies and seed box; and this effected by pushing the bar, S R, fig. 1. which is fixed by its end, R, to the board that supports the hoppers; thus when the seed box is pushed forward the cords slacken so as to suffer the hind part to be drawn by the collar, f; and the cylinder no longer turning, no seed is dropped. When you would sow again, the bar, S R, is drawn back, and the cords acting on the back pullies the seed drops.

The two drills I have described may enable the husbandman to save a great deal of seed. But these instruments cannot be used in very stoney lands, nor in soils that are clayey, and turn up in large clods; in fact these drills can only be used in fields
that

that are plowed flat or in broad lands. They will not sow ridges; to do that some little drills must be contrived to fix to the plow, in order to drop the seed as the furrow is turned. I shall refer to what I have said on this subject in my sixth volume of husbandry. If the experiments I propose making succeed in time, I may possibly say something more on the subject before this volume is printed off.



C H A P. III.

Of several other Instruments of Husbandry.

THE harrow is too well known for a description of it to be necessary, I shall say a few words on its use.

The ordinary harrow is for covering the seed sown on the fallows. It is also used for taking off the land the roots of weeds which the plow has turned up, and for breaking the clods. For these last uses they must be very substantial, and the teeth should be strong iron pins, and they must even be often loaded with stones.

In very populous provinces, where land is dear, they break the clods with long handled

handled mallets; but this is more frequently done with wooden rollers, eight inches diameter, and eight or ten feet long; these rollers serve also to roll oats. Some English Husbandmen use stone rollers, which by their weight break clods on which wooden rollers would have no effect; but if the land is wet, these heavy rollers knead it, and take away part of the benefit of the plowings.

The rolling harrow, composed of two large rollers armed with iron spikes, as it appears in plate 5, figure 3. seems to me to be the best, provided the land is not so clayey as to choak up the teeth. It is not however possible to invent implements that will suit every soil: every one must chuse such as are best suited to his particular purpose.

B O O K VIII.

Of the Culture of different kinds of grain.

W HATEVER I have hitherto said on the culture of grain must be chiefly applied to the wheat sown in autumn, which remains the whole winter in the ground; yet these general principles may in some measure be also applied to every production of the earth; tho' there are some particular points respecting each kind of grain, which merit observation, but which will not long detain us.

SECT. I. *Of summer wheat.*

We have already observed, that there is a kind of small wheat sowed in spring, but cut at the same time as that sowed in autumn.

I should imagine, that in favourable seasons the winter corn might be sown in spring, and bear a tolerable crop; but I know by experience these favourable years happen seldom: and, that for the most
part

part each seed will bear only one or two stalks, and very small ears; but the summer wheat always succeeds when the year is favorable for spring corn. It is then this kind of wheat which must be distinguished from the winter wheat. There are two sorts; one with awns, (*triticum vernal aristatum*); and the other without awns, (*triticum aristis carens*;) they are both wheats, but less than the winter corn; they make however good bread.

Farmers often sow this wheat on their spring-corn lands; they winter-fallow it as soon as possible: after wheat seed-time they give the land a second plowing towards February; covering the seed, when they sow, with a harrow, or a plow, according to the nature of the soil.

Summer wheat succeeds much best when it is sown on the winter-corn lands. If for instance the uncertainty of the weather hindered the farmer from sowing all his wheat in autumn; by sowing the land with summer wheat he will be morally certain of a good crop, particularly if the summer is not too dry.

As this corn is less in size than common wheat, less in proportion must be sowed;

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that

that is, if ten bushels, Paris measure, of unlimed common wheat, is sowed, which will be twelve bushels when it is limed, only nine bushels of unlimed summer wheat should be sowed, which when limed makes about ten bushels and a half. Tho' the quantity is thus lessened, the corn comes up thick, because being small the sower's hand holds more of it: but it branches less.

It is to be observed, that the summer wheat is at least as much subject to smut as the other: it must therefore be limed, and even washed in lye.

There are two reasons which prevent farmers from sowing much of this wheat; first, because it shales much when ripe: if a husbandman sows only eight or ten acres of this wheat, he can contrive to get it in as soon as it is ripe, or even rather before; for he would lose a great deal of corn if he had eighty or an hundred acres to get in, it shales so much.

The second reason for not sowing so much of this grain, is that a farmer is under a necessity of parcelling his work. One hundred acres of barley and oats to be sowed in spring will fully employ him; what

what then would be the consequence if he had also one hundred of summer wheat to sow? By sowing his wheat in autumn, and his soft corn in spring, his work is regularly performed.

In some cases it is however very profitable to sow summer wheat.

1. When rain in autumn prevents the sowing wheat, then the summer wheat is a happy resource in spring.

2. If by any accident, as by frosts or insects, the seed sown in autumn is destroyed, the summer wheat supplies its place.

3. In countries where the corn is subject to be devoured by game, the summer wheat is least in danger, not only as it is a shorter time on the land, but because when it is green the game is not in want of food.

4. Lastly, I should be apt to think, that in wet soils, where the corn is subject to be flooded in winter, summer wheat had better be sown.

Thus, I am of opinion, that farmers ought every year to sow a little summer wheat, and not sell it till summer, when the dangers of the winter are over; reserving to themselves that resource in case of need: this they cannot do when they are

in a hurry to thrash it, and carry it to market; which is generally the case.

Summer wheat will live through mild winters, and in that case yields a better crop than when sowed in spring.

SECT. II. *Of many-eared Wheat, (Triticum Spicâ multiplici, Pin.)*

Many-eared wheat, which is also called Smyrna or Sicilian wheat, bears, as we have already observed, besides the main ear, several lateral ears; so that the whole taken together is as big as a pullet's egg. The size of this ear seems to promise a plentiful crop; and indeed I have myself had, from seven pounds of seed, four hundred and thirty pounds of very good corn, of which good bread was made: but this grain does not succeed but in well-manured and well-tilled land, as it requires much nourishment.

This wheat is sowed in autumn on well-dunged and well-plowed land: less seed is used than even of the summer wheat: in other respects there is nothing particular in the culture of it.

M. Delu

M. Delu has observed, that it should be sowed pretty deep: he tried one year to sow some of this wheat at the end of March: it spindled well; but the heats at the end of August, when it was in bloom, prevented the grains from forming: on the contrary, a small quantity he sowed in a garden in February yielded more than summer corn sowed in spring generally does.

This experiment does not surprise me; for, tho' autumn wheat sowed in spring seldom succeeds, in hot and wet years it may yield good corn; but these cases rarely occur.

Smyrna wheat is about the size of summer wheat; but it exceeds common wheat in weight one twelfth.

SECT. III. *Culture of Rye, (Secale seu Farago.)*

There are two sorts of rye; one sown in autumn, (*secale hibernum vel majus*, Pin.) the other sown in spring, (*secale vernum vel minus*, Pin.) I can't say much with respect to the summer rye, as I have hitherto been able to procure but small samples of it. The winter rye is cultivated like

the winter wheat; and the summer rye like the summer wheat, except that it is sown a little later.

As rye is smaller than wheat, they sow in our neighbourhood after the rate of ten bushels, Paris measure, to an arpent of an hundred perches, each perch twenty-two feet.

But the great use of rye is, that it thrives on light lands, that are improper for wheat.

As this grain is not subject to be either smutty or burnt, they do not lime it; but it is more subject to the distemper called *ergot* than wheat. The *ergot* has been treated of already in the book on the distempers of grain.

Rye is less subject to damage from the game than wheat, particularly the birds: it is besides easier preserved in granaries.

Rye straw is not so good for cattle as wheat straw; but it is very useful for making bands.

Rye is sometimes sown to be cut green: we shall take notice of this in the chapter of artificial pastures.

In indifferent land they sow a mixture of wheat and rye, which they call *maffin*:
and

and as the land is more or less proper for wheat, more or less rye is mixed.

SECT. IV. *Of naked Barley, called by the French Epeautre, (Hordeum distichum, Spicâ nitidâ: Zea seu Briza nuncupatum, Inst.)*

Naked barley is a kind of grain that holds as it were the middle space betwixt wheat and barley: its flour is nearly as good as that of wheat; but as it has a great deal of coarse bran, tho' it is not bearded like barley, it is not esteemed so valuable, yielding very little fine flour: besides, the bread made of naked barley dries soon, and is not white like that made of wheat. This grain is not nice with regard to soil, whether it be light or clayey; and as cattle will not touch the straw of it, farmers never raise it but in lands that will bear neither wheat nor rye.

It resembles wheat in its culture, except that it must be sown earlier, tho' it is later ripe.

Writers mention two sorts of naked barley, one of which grows higher than the other; but I have seen a kind with

white ears, and another with ears of a deep red colour. Naked barley is very little cultivated on our side of the Gatinois, except near Montargis: the bread made of it is well tasted; but nothing near so sweet as that made of wheat.

SECT. V. *Of Barley, (Hordeum.)*

Botanists mention many sorts or varieties of barley; but we shall only take notice of those generally cultivated.

There is one which may be called winter barley, because it is sowed at wheat seed-time: it is the *hordeum polystichon bibernum*, Pin. It is called square barley, because the kernels are fixed in four parallel lines, which give a square form to the ear: it is called also bear and big. The kernels are large, and it is very fit for malt. As bear has a great deal of bran, as its straw is not very good for cattle, and as it is with difficulty kept, the chief benefit resulting from it is, that it yields good crops: it is chiefly sowed for poultry, and to be cut as green fodder for horses: we shall mention it among the artificial pastures. This grain is a great help to the poor in years of scarcity,

city, tho' it is a coarse food: it is besides early ripe.

The spring barleys are, 1. That kind of square barley called *hordeum polystichon vernum*, Pin. As I have never seen this kind, I cannot say whether the culture of it is profitable or not.

2. Common barley with flat ears, (*hordeum distichon, quod spicâ trinos ordines habeat*, Pin.) this sort encreases much: a great deal of it is raised in many countries.

3. The barley to which the countrymen give the name of rice, because its kernels are white and have but little bran: this is the sprat or battledore barley; (*hordeum distichon, spicâ brevior et latior, granis confertis, sive oriza germanica*, Pin.) I have seen fields of it raised by countrymen who have held it in great esteem: however, this kind is not yet introduced into our province.

Bear is sowed before wheat, in land well plowed and dunged. Every kind of barley yields large crops when it is sown in good land well tilled and dunged: they thrive better in kindly soils than such as are stiff and clayey. In some provinces their crops of barley are of such consequence,

quence, that they cultivate it almost with as much care as wheat. Barley is generally sown on the spring-corn lands: after wheat seed-time, the land is winter-fallowed; in February or the beginning of March it has a second plowing, and is immediately sowed, in the proportion of eight bushels to an arpent. If gentle rains follow, the barleys come on well enough; but they never thrive so well as when they are sown on land prepared as for wheat.

This grain is said to exhaust land more than any other.

Barley mixed with a little wheat makes good bread; it is besides very useful for feeding poultry and even horses. Barley meal mixed with milk, after the manner of rice, is known to be good food.

SECT. VI. Of Oats, (*Avena*.)

We grow in our provinces two kinds of oats; that is, the winter oat, (*avena biberna*) and the summer oat, (*avena vulgaris alba aut nigra*, Pin.) I have sometimes sown in a kitchen garden a small quantity of a kind of oat that has scarcely any bran, and which is therefore called the naked oat, *avena nuda*, Pin.

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The winter oat is sown on the spring-corn lands. The first plowing is given immediately after harvest, and the second at wheat seed-time when the oats are sowed. When these oats succeed, they yield better corn, and in larger quantity, than the summer oats, and they suffer less by the drowth of the summer. But two things prevent farmers from breeding any quantity of them. First, though this kind is not so soon hurt by frost as the common oat, yet frosts sometimes damage it; and after a hard winter it stands very thin in the field: besides, the farmers are so busy sowing wheat in autumn, that they are glad to defer their soft corn till spring. I might add, that in lands that retain water, much of these winter oats perish: to this the summer oat is not so subject.

With respect to the naked oat, I can say little, as I have only raised it in small quantities, and merely through curiosity: I only know it makes very good oatmeal.

The common oats are generally sowed on a single plowing, and they succeed pretty well when the land has before been well prepared for the wheat; when manure has not been spared, and it has had four good
5 plowings

plowings before the wheat was sown. Yet in general, it is better to give the land a winter-fallowing after wheat seed-time, and a second plowing before the oats are put in the ground. The sowing is, indeed, sometimes retarded by this winter-fallowing: the plowed land, being more permeable to the water, is not so soon dry and fit to receive the seed as that which has only a single plowing: it is this, however, that hinders the farmers from giving the winter-fallowing I propose, because they would keep the feed for their flocks.

They sow a sixth part more oats than barley: in our grounds, where they use eight bushels, Paris measure, of barley, they use ten of oats, without liming the seed, tho' this grain is at least as much subject to be smutty as wheat.

When oats are three or four inches high, they take the advantage of a gentle rain, in fields plowed flat or in broad lands, to pass over them a wooden roller, which breaks the clods and gives fresh earth to the roots of the plants, and at the same time lays the land level, without which it could not be mowed close.

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In the vine countries, when the country-women are no longer admitted into the wheat, they pull up the weeds of the oat fields, and feed their cows with them : but in countries where this is not the custom, the farmers employ weeders.

Wherever the land is not plowed in ridges, oats are mowed ; but it is customary to cut them green, letting them lie till rain enough has fallen to penetrate the swarths. The oats, they say, grow ripe on the land, the grain fills, grows black and weighty. I own I have no conception that rain water can be productive of all these good effects ; and believe prejudice has here great sway : when I have found fault with this method, all the farmers appealed to experience ; but what is their experience ? None of them ever let their oats ripen before cutting, or ever housed them without gaveling, to compare their grain to that of gavelled oats. Their experience consisted in having done as they had seen others do, without knowing any other practice.

M. Delu did not give into this error. His land, which he has mended and brought into good tilth for his wheat, afterwards yields him a good crop of oats, which he
cuts

cuts not till perfectly ripe, and houses them as soon as cut, without waiting for rain, or suffering them to be tied up; his oat stubbles assume no verdure like his neighbours, because his oats have not shaled; his corn constantly weighs a seventh part more than others, and his neighbours are fond of it for seed, yet follow not his example.

Oats should not be housed till the grass cut with it is dry; or the stack will heat so as to prevent its being fit for seed.

It is a common saying, that old oats are not fit for seed; yet Don Le Gendre, not liking his new oats, sowed such as were old, and had amazing success: I must particularly recommend, that before oats are sowed, a trial be made of the seed, to see if they come up well.

SECT. VII. *Of Millet, (Miliun & Panis Punicum.)*

The several kinds of millet should be distinguished from the panic, the first growing in clusters, the other in long ears.

There are many sorts of millet, but I shall only treat of two; that is, 1st, the great millet or Guinea corn, which the botanists

tanists call *milium arundinaceum*, *sorgo nominatum*; its seeds are white, yellow, red, or black; 2d, the smaller or common millet, with white, yellow, or black seeds.

There are also many varieties of the panic, as well in respect to the form of the ear as the colour of the seed; but they are all of equal goodness. To enlarge much on the several kinds would be needless; I shall therefore treat of the millet and panic in general, all the kinds being cultivated in the same manner. Millet thrives best in a light sandy soil, well manured. The land has two plowings, in the last of which shallow furrows are made, in which the seed is cast rather thin and immediately covered: some think, that when the land is dry, this seed should be sown in the evening only, and left all night without being covered, to have the benefit of the dews; that it should be covered early the next morning with a harrow, and then rolled to press the land close.

Young millet is soon damaged by frosts, even by those of the spring: it is for this reason they sow it so late, that is, in May: in provinces where they are not apprehensive of frost, they sow it the beginning of May,

May ; in other places at the latter end : the latter crop of millet is sowed towards the end of June. In some rich lands and warm exposures, they sow it on land that has borne a crop of rye or wheat, plowing it immediately after harvest, at the same time sowing the millet or panic.

A month after the millet is come up, the plants must be thinned, and set at seven or eight inches distance, or they will bear little : this is proved by repeated experiments. They must afterwards be hand-hoed, and this is all the tillage they require. But when the grain is formed, great care must be taken to keep off the birds, or they will reduce the crop at least one half.

Millet sown in May is cut in September, but that sown the latter end of June is not ripe till towards the end of October. The cold of the autumn is less hurtful to millet than that of the spring, yet the latter crops are always less plentiful. Women are generally employed for getting in millet : they cut the panicles or the ears of the panic near the last joint ; they put the ears in their aprons as fast as they cut them, and empty them in sacks or baskets, which are carried in carts into the barn where they
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are laid in heaps covered with cloths: five or six days afterwards they are thrashed. When the corn is cleaned and winnowed, it is dried in the sun; without which it would soon rot, for it is of all others most subject to be damaged by being moist; but when it is once well dried, it may be easier preserved and longer than any other grain; and though it is seldom stirred, the weevil does not touch it.

The great millet, called *sorgo*, or Guinea corn, which grows five or six feet high, should be sowed thinner than the other.

Millet, the flour, mixed with that of wheat, makes pretty good bread; but bread made of millet flour alone is heavy and hard of digestion.

To clear millet of its husk, it is beat in wooden mortars, or passed through a mill that is not set close enough to break the grains: this is often used instead of rice. This grain is excellent food for poultry: the red and black sorts are especially given them.

As millet is said to exhaust land, careful farmers never sow it the year before wheat; for, besides impoverishing the land, it prevents it from receiving the due plowings,

and occasions the wheat to be sown too late : it is therefore best sown on spring-corn lands.

M. de Baudignan, who lives near Nerac in Guienne, has communicated to me a method of working land, which is worthy of notice in this work. The lands that are in tillage in this province yield two crops a year ; one of rye, and the other of panic or millet ; consequently they are never in fallow. Towards the end of October the dung is carried on the land, and spread as regularly as possible : the rye is sown on the dung, and turned in with the plow, the land being laid in deep furrows and narrow high ridges. In March it is hand-hoed ; and the furrows between the ridges are got ready to receive the millet or panic. In April the millet or panic is sowed and covered with a hoe ; so that soon afterwards alternate rows are seen of millet and rye. In the beginning of May the corn is hoed with a short-handled narrow hoe. This is scarcely finished before the millet or panic is thinned with the same instrument : by this time the rye has attained its full growth. At Midsummer the rye is cut, and left in heaps in the field till August :
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it is then carted, and as soon as the field is clear, the labourers hoe up the stubble, to destroy the weeds. Soon afterwards the land receives another stirring; and the panic or millet is earthed up. When this is done, they thrash and clean their rye. Afterwards, in September, the millet is got in and laid in large heaps in the barns. In October they cut the panic: this grain is late ripe, which often occasions considerable loss, being so subject to injury from frost: it is laid in great heaps covered with straw, and is not thrashed till March following. When the field is clear, they carry on fresh dung, and sow the rye where the millet before grew, and cover it by splitting the ridge with a plow where the rye grew: by this means the rye lies on a hard bed of earth full of weeds and millet stalks, which are never pulled up.

It must be evident, from what has been said, that there cannot be a more laborious or defective method of husbandry: and the goodness of the crops is owing to the quantity of dung used, and to the stirrings given whilst the plants are in their growth. But M. Baudignan joins with me in thinking, that they are much to blame in not

giving the land some good plowings before sowing.

SECT. VIII. *Of Turkey Corn, Spanish Corn, Indian Corn or Maize.*

There are several kinds of maize, but they differ only in the colour of their seed, which is either white, yellow, dark or light red, greenish or variegated: these are only varieties not worth attending to.

Land intended for maize must be twice plowed before March. It must then be dunged, for maize will not do without it; towards the end of April the trenches are formed, which makes the third plowing; the clods are then broke by hand, they lying so that neither a harrow nor roller can be used.

In May a fine day is chose for sowing: this is done by making holes at the bottom of the trenches, and in each hole are dropped two grains of maize. These holes are to be made at a foot and a half distance in the trenches, and the trenches at the same distance from each other. When the maize is come up, the weakest plant is drawn up where both the seeds have risen; and where

where neither of them have appeared, two fresh seeds are sown.

About the middle of June a slight hand-hoeing is given to each plant ; and as the plants are in a trench, the mould of the ridge falls in, and earths them up from time to time.

Towards the end of July a second stirring is given, and the plants are carefully earthed up.

About the middle of August the panicles of the male flowers are cut off ; (these panicles are empty ears at the top of the plant) but the ears must be impregnated before they are cut, at which time the sheaths appear swelled : some plants are impregnated a fortnight later than others. The panicles are excellent food for oxen.

Some time afterwards the leaves are taken off, and the burnt and empty ears : they say, that if they were left on the plants, the good ears would not grow so large, nor the grain be so plump. I think it very proper to cut off these ears, but rather imagine that taking away the leaves hurts the plants ; and this custom was probably introduced for the benefit of procuring fodder for oxen,

which are very fond of them, and particularly so of the burnt ears.

Maize is cut in September. When the ears are cut, they are gathered up in baskets, and laid in heaps in the field: they are then carried into the barn and divested of their sheaths; and being dried in the sun, they are laid in the granary.

As soon as the maize is got in, the stalks are cut close to the ground, and are kept for winter fodder for the oxen. The roots are afterwards pulled up, as they would be an impediment to the plowing.

The field must be turned up as soon as possible; to prepare it for another crop.

There are several methods of separating the grain from the ear: one is by thrashing; this is most expeditious, but is apt to bruise the grain: the best way, and that most in use, is to rub the ear against the edge of a flat piece of iron. The remains of the ear is given to the oxen.

When the grain has been separated, and well dried in the sun, it may be kept for many years; and let it be ever so old, it will still be proper for sowing.

Some say, that maize keeps best when separated from the ear: it may indeed be
easier

easier stirred with the shovel. Others, who say it is less subject to be attacked with the weevil whilst in the ear, tie it in bunches and hang it on poles laid across their granaries.

As to that which is separated, it is kept like other grain; and stirring it once in two or three months is sufficient.

SECT. IX. *Of the Culture of Maize in the Angoumois.*

Maize, which is well known by the name of Turkey corn, or Indian corn, is called, in the Angoumois and the Limosin, Spanish corn.

In the first-mentioned province they sow it with the broad cast on a stubble, and plow it in; this is generally the only plowing that is bestowed on it. They use for an arpent of one hundred perches, each two and twenty feet, as much seed as will fill a measure that contains seventeen pounds weight of wheat; and it is sown during the whole month of April. When the corn is come up, it has a hoeing, which they call *setting out*, as they thin the plants at this time, and break the clods to lay the land level.

When the plants are about seven inches high, they have another hoeing, which is called the *cleaning*, as the weeds are to be destroyed, and such plants as grow irregular are cut up, the rest being left at about one foot and a half distance from each other. If the season proves rainy, they sometimes require another *cleaning*.

When the plants have got to the height of twelve or fifteen inches, they have a thorough hoeing, and the plants that are suffered to stand are carefully earthed up; the rest, which stand too close together, are pulled up; and as they have now acquired some substance, they are gathered as fodder for the cattle, which are very fond of them: the standing plants soon push new roots into the fresh earth.

When the maize has put forth its panicle, they cut it off, giving it to the oxen: some dry it, in which state it serves the oxen for winter fodder: this is done in August. This corn is cut at the end of September, or beginning of October. It is cut with a hook near the ground, and carried into the house, where the family break the ears from the straw in the evenings: some leave them in their sheaths, hanging them in

bunches in the granaries, where they keep well, till they have occasion to separate the grain from the ear: others take off the sheaths and lay the ears in granaries to the thickness of five or six inches, turning them often to keep them from moulding.

The sheaths of the ears make very good mattraſſes; but they are more commonly given to the oxen in feed-time, when their work is hardest. The straw is put into the cribs for them; what they leave makes dung.

When the ears are very dry, they separate the grain from them. Some do this by fixing a thin iron to the handles of a vintage basket; and rubbing the ears against it, the grain falls into the basket.

This corn makes, as I have already observed, pretty good bread; but as the dough does not rise well, it is necessary to mix some wheat or other meal with it. It is given in the ear, and in the grain, to oxen and hogs that are put up to fatten; and poultry eat it; but before it is given to chickens, it must be broke in a mill.

This grain should be sowed very thick, when it is intended to serve as fodder for hard-worked oxen: in this case it must be
sowed

sowed late; that is, after flax is pulled, or even after barley harvest: by this means it may be cut the whole month of October and part of November, to be given green to the oxen.

Dry weather greatly hurts this grain; winds lay it; and it is besides subject to various distempers; and if care is not taken, the weevils destroy it in the granaries.

Maize is so far from giving bread a bad taste, that it makes it palatable; but then there must only be an eighth part of maize flour to seven parts of wheat flour. Bread made of maize flour alone is yellow and heavy, because the dough does not rise well; yet some country families have lived on it a year together without an inconveniency attending it.

Maize is said to impoverish land much; yet good crops of wheat are got after this grain, because the land was well dunged before the maize was sowed, and had three good hoeings whilst it was on the ground: by this means the land is so well stirred as to require but a single plowing before the wheat is put into the ground.

M. Aimen says, 1. That maize should be sown the beginning of May, as it will then
 2 better

better support the summer heat and bear finer ears.

2. That the panicles should be cut before all the sheaths of the ears are open, leaving one in about the distance of every fathom; and that this is sufficient to impregnate all the plants.

SECT. X. *Of Buck wheat, (Fagopyrum.)*

This plant will do pretty well in poor, light, sandy and stoney soils: it is therefore seldom sown on land that will bear wheat, but on rye lands. Buck wheat is sown at two seasons; that is, after the spring corn is in the ground, and about harvest time; but this last crop seldom succeeds if there are frosts in autumn. Buck wheat is generally sown on spring-corn lands that have had two plowings, one in March or April, the other in June; immediately after which it is sown in the proportion of a measure that will hold one hundred pounds of wheat on an arpent. It is also sown on land that has borne a spring crop, that has not too long occupied the ground. When buck wheat is sown, it requires no farther care till it is ripe, which is generally one hundred days after

after sowing ; so that corn sowed in June is reaped in September.

It is said, that lightening injures buck wheat greatly when in bloom. Unfortunately there is no remedy for this evil ; but when buck wheat succeeds, it yields large crops, and is very good food for poultry. The peasants make of it a kind of dough, which they bake on griddles : they also make of it a kind of very dark crumbly bread, which I have yet seen heartily eat in provinces where they grew very good wheat.

What prompts them to grow buck wheat, is its thriving in poor lands, its yielding largely, and its not impoverishing the soil much : beside, the straw makes good fodder.

SECT. XI. *Remarks on the Culture of the several Kinds of Grain treated of in this Book.*

All the kinds of grain I have mentioned, may with advantage be cultivated in the new method ; yet plants that occupy the land for any length of time receive most advantage from it. It is reasonable to think, that rye, which is sown in September, and cut in July of the following year, is more benefited

benefited by the New Husbandry than barley, which is sown in March or April, and cut in July, or the beginning of August.

But such crops as are obliged to be hand-hoed, receive most benefit from the New Husbandry. For instance, maize sowed in rows, with intervals wide enough to admit the cultivator or horse-hoe; the first stirrings are given much cheaper than it could be hand-hoed, and when the plants are to be earthed up, adding a small earth-board to the cultivator effectually does it. This single example is sufficient, as it may easily be applied to other crops. I have enlarged more on the subject in my Treatise of Husbandry.

BOOK IX.

Of Meadow and Pasture Land.

CATTLE are a material article of profit in farming: many are employed in tillage, and they all of them supply the largest part of the manure that enriches the land. They cannot therefore be in too great a number; but it is necessary to have pastures to supply them with food: these pastures are divided into natural and artificial.



CHAP. I.

Of natural Pastures.

Natural pastures are fields which produce of themselves the several sorts of grass: they are divided into low meadows and upland pastures.

SECT. I. *Of low Meadows.*

Low meadows are such as by their proximity to water are subject to be overflowed. When the water lies on them great part of the

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the year, they are called moors, and produce only rushes, flags, reeds, and other aquatic weeds. In this state they yield a wretched pasture, and the cattle poach the land and make it still worse: milch cows soon become dry in them. In order to improve them, cattle must be kept out, drains must be cut, and the earth of the drains spread on the moor; any earth that is carried on it, let it be ever so bad, will be of service. To save a part of this expence, I contented myself with digging ditches and planting alders. The lower moors lie, and the longer they are under water, they must of course be worse: mine have a bottom of turf.

Putting moors out of the question, what are generally called low meadows are lands that are indeed near water, yet are subject to floods during a part of the year only: their grass is coarse, but there is a great deal of it. The meadows are a useful resource in dry seasons, when the grass, which is scarce every where else, is here of a better quality than in wet summers. These meadows may be improved by draining, and by carrying soil on from time to time. When this is done, it is proper to strew the land with sweepings of hay-lofts. Dung is of little service to these

these meadows, as the inundations carry it off: earth is therefore preferable.

Cattle spoil these meadows, the ground being too soft; but when they are drained, they may be fed. The less time the water lies on them, the better they are.

SECT. II. *Of Upland natural Pastures.*

Among the upland natural pastures may be comprehended wastes, heaths, and downs, which are large tracts of land, but indifferent in quality, for the most part producing but little grass amongst a great number of rushes, junipers, brambles, heath, fern, &c. in-somuch, that a large extent of land will maintain but few cattle: the worst among them are such as have most heath and fern.

To improve such land, it must be broke up with the cobbing-hoe, and have several plowings. Ryeshould first be sown, and afterwards oats, or some other grain; and the last sowing, some clover seed should be scattered. If a few ashes are spread, or some other manure, the clover will be good for several years, and the natural grass which succeeds it will be in heart for a long time.

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The good upland natural pastures require a rich deep soil: some, which are situated on the brow of a hill, may be watered, in times of drowth, by ponds or reservoirs. These pastures are doubtless the best; but we cannot always have them; and great care is necessary to keep the ditches in order that carry the water from the reservoir, as well as the trenches that serve to distribute it over the land. These trenches are easily made: when the land has a gentle descent, the water is brought in at the highest part of the field, and little trenches are cut perpendicularly to the slope: the same thing is done when the slope is greater, but the trenches must in proportion be more in number. In very hot weather the pasture should be watered once a week: the current of the water will sometimes put the trenches out of repair; but as the grass must not be overflowed, every time the field is watered, the trenches, if they want it, must be repaired.

In my opinion, we are too negligent in not having these reservoirs. On examining the level of our land, we should often find, that by means of a ditch or two, and a few trenches, a kind of pond might be formed

at the upper part of a field, that would be infinitely serviceable in dry summers. In some cases an advantage might be made of the land-floods, but care must be taken that they bring no sand down with them. In the Limoufin, the Angoumois, and other provinces, are meadows on the banks of rivers, so much above the level of the rivers, that they are never flooded, and even suffer from the summer's drowth. The inhabitants find a means of watering them by dams: these raise the water to the trenches, which disperse it over the land, and fertilize it. Every kind of water is not proper for fertilizing pastures: the meltings of snow are thought to be worst; spring water is reckoned better; then river water; but pond water is best of all.

The other upland pastures, which cannot be flooded, are such as lie level on a good soil, a little damp, rather clayey than sandy. These require,

1. To have good ditches kept round them, to carry off the superfluous water, to keep out cattle, and prevent paths being made over them.

2. The stones must be picked off, and the mole-hills beat down, that the land may

lie level, and the scythe go close to the ground.

3. Every two or three years, manure must be laid on them; such as well-rotted dung; or, what is better, the scourings of ponds and ditches, wood or turf ashes, or foot. Pigeons dung is very good to kill moss and rushes; it makes the sweet grass grow apace; but the feathers that are mixed with it, which do not rot, mixing with the hay, give horses very troublesome coughs. Long dung must never be laid on pastures; for when the straw has been washed by the rain, the grass raises it from the ground; and by mixing with the hay it lowers its value.

4. I should imagine it very proper, particularly for destroying moss, to cut these pastures with M. de Chateauvieux's coulter-plow. Dung should be spread on pastures in December and January, but ashes not till March. Some, to prevent their hay receiving damage, gather up in spring, when the grass begins to shoot, the straw of all the dung they laid on in winter, and lay it on their plowed lands.

5. There should be no trees in pasture lands: their roots impoverish the earth, and their shade hurts the grass. Even from the

hedge-rows such trees should be excluded as drop feeds that will of themselves grow amongst the grafs; and care must be taken to pull up all broom, rushes, brambles, and fern.

6. Lastly, every time dung is laid on the pastures, it will not be amiss to scatter the sweepings of hay-lofts, and even a little clover-seed, on them.

These pastures, without dispute, bear the best grafs for hay, and they afford afterwards a good rowen for the cattle.

It must not be imagined, that natural pastures require neither care nor expence. By following the practices I here recommend, I have more hay from six arpents of land, which I keep in my own hands, than our tenants have from thirty acres of the same kind of land.

When pastures have been long neglected, they may be improved by cutting them, as I have said before, with M. de Chateauvieux's coulter-plow, by sowing good hay-seed, particularly clover, and by dunging them well. This will destroy the rushes and moss; but if they have been so long neglected, as to be full of fern, heath, broom, junipers, brambles, and wild rasberies, the best way is to break them

them up, plow them and put them in corn; (we have already described the method of breaking up lands;) but they must not be laid down again, till the fern, heath, &c. are entirely extirpated. At the last sowing, some hay-seed and clover-seed must be scattered, and the field must not be dunged till the turf is pretty well formed. When the old pasture is first broke up, it may be proper to lay on some dung before the corn is sown; but I am of opinion, that no dung should be spread the year in which it is intended to lay it down again in grass.

At the last sowing, which had best be with oats, it will be proper to plow the field flat that is to be laid down, then harrow it, break the clods, and roll it to lay the land even, that the scythe may cut near the ground; and for the same reason all the stones are to be carefully picked off. The land thus laid down again in pasture will for a long time bear good grass, provided the directions above given are followed; but cattle must not be turned into it till the turf is well formed, neither must it till then be flooded: when the land is well settled, cattle will do it no hurt, unless after a thaw, or great rains.

For the first two or three years it will be of service to cut up the large weeds, such as burdocks, henbane, thistles, &c.

As the season for cutting hay is near harvest, it must be retarded as little as possible; it is best to cut the grass before the bloom is past; but if the weather proves wet, as the grass takes much less damage whilst it is standing than when it is mowed, it should not be cut till the weather clears up. The grass, it is true, grows sticky, and is yellow at the top; yet this method has succeeded well with me; and I have sometimes got in my hay in very good order, when that which was cut in the rain was black and half rotted. In fine weather the mowing should be forwarded, not only because the hay will thereby be better for the cattle, but also because a second crop may be had the same season, or there will at least be very good pasture.

When the grass is cut, a sufficient number of hay-makers must be provided, either men or women: if the weather is fine when the upper part of the grass is dry, it must be turned, and this must be often repeated; but if it is likely to rain, it must be made up into cocks of half a load each. The
grass

grafs whilst green would soon heat in these cocks; but as soon as the rain is over, and the wind blows or the sun shines, the cocks must be opened and spread out: if it is still likely to rain, the cocks must be made up again: and this must be continued till the hay is quite made; insomuch, that in rainy weather the cocks are obliged to be opened and made up again several times in a day. I allow this work to be troublesome and expensive; yet is it, in these cases, the only way to prevent the hay from being spoilt.

As soon as the hay is made, it must be gathered up with forks and rakes, and made up into cocks, and as soon as possible carried into the barn, or made into stacks placed on high dry ground. When the hay is not put into the barn till it is made into trusses, these trusses are of the ordinary weight; but when it is to be kept in stacks, it is loaded on waggons without being made into trusses, and stacked in a conic form, and thatched with straw like wheat-stacks. If straw is scarce, the hay is used for this purpose, which is no great loss. In making these stacks they often place a balk in the middle, and raising the stack round it, at the top they tie withs, to which they hang

weights, to prevent the top of the stack being carried away by the wind. When a stack is well made, the hay will keep several years, and when it will fetch a good price, it is made up into trusses, and sent to market.



CHAP. II.

Of artificial Pastures.

WHEN our land is not adapted to natural grass, we must have recourse to artificial pastures. They are made by sowing some well-tilled land with certain vigorous plants, which grow apace, and yield a great deal of fodder for cattle. These are either annual or perennial. The annuals usually sown are peas for sheep, or vetches, Indian corn or maize, rye, and bear or winter barley. The perennial plants are saint-foin, lucerne, clover, ray-grass, &c. The society of Agriculture in Bretagne intend to raise apart most of the plants that naturally grow in the fields in that province, that they may know, in the sequel, which yields the most and best fodder for their cattle.

They

They will certainly by this means propagate plants, which at length may be formed into artificial pastures; but they will do well to extend their trials to foreign plants, as well as to such as are natives of their province. As almost all plants that bear leguminous blossoms are good for cattle, we should endeavour to cultivate them, not forgetting even shrubs that bear flowers of the same kind.

Before I mention the plants commonly cultivated, it is necessary the reader should recollect, that artificial grasses are not only useful to supply fodder for the cattle, but they also supply the place of dung, as is mentioned in the Chapter of Manures.

SECT. I. Of Lucerne (*Medica major et erectior, Floribus purpureiscentibus, aut violaceis, Pin.*)

There are several kinds of Lucerne, but that of which I have given the Latin name is the only one cultivated for fodder for cattle: some writers have called it *Fenum Burgundicum*. This kind produces very strong, vigorous, perennial roots: from them rise several stalks two feet and a half, or three

three feet high: they are round, support themselves well, and are larger or smaller according to the nature of the soil. These stalks push out branches on all sides, chiefly towards the top: from one end to the other of the branches are a number of leaves, in form of a trefoil; whence it has been by some writers called *Trifolium Burgundicum*. The flowers are legumenous, purple or violet, and produce a pod of a spiral form, containing seeds in shape somewhat like a kidney. This plant has a slight taste of cresses.

Lucerne thrives best in rich light lands that have a great depth; it does not succeed in dry parching soils, nor in clay, tho' it requires some moisture. If it is flooded, and the water remains long on it, it dies.

Lucerne is soon choaked by other plants: it must therefore be sowed on land that is quite clear of weeds and grass, and that has been brought into excellent tilth by frequent deep plowings. Thus, grass land cannot be sown with Lucerne till it has borne several crops of corn, and been dunged; but, as we have already said, it must not be dunged the same year the Lucerne is sown.

In

In the southern provinces of France, Lucerne may be sown in autumn; for as there are no hard winter frosts to be dreaded, it takes firm root in that season; but with us it is better sown in March. Three or four ounces of seed are spread on every square perch of twenty-two feet.

The Lucerne seed is mixed with half as much oats, and both sowed together: the last plowing should be very fine, lest the Lucerne seed, which is small, be buried too deep: it is covered with the harrow.

I have already said, that Lucerne does not thrive in the neighbourhood of other plants: it should therefore be weeded; but the expence and trouble of doing it is endless, unless in the New Husbandry; but before I explain this, I shall continue my account of the common method of raising it.

When the oats that were sown with the Lucerne are ripe, they must be moved close to the ground; and tho' the Lucerne should be cut with them, it will shoot again speedily.

But if the weather was so favourable as to make the oats branch much, as they might then choke up the Lucerne, they must be cut green, and given as fodder to cattle: for it is much better to lose the crop

crop of oats than hazard the loss of the Lucerne. It will be proper the third year to dung the Lucerne, in the manner I have directed for natural grasses. Such as have opportunities of watering their Lucerne, should avoid doing it, except in very dry weather, and then so much water should not be used as in natural grasses.

To have Lucerne continue long in perfection, it must never be fed with cattle, but always mowed when the flowers are half expanded.

As this plant shoots afresh as soon as it is cut, it may, with us, be mowed three, or even four times a year, and in the southern provinces, five or six times; but this must be understood of Lucerne in its full prime, and this begins the third year after it is planted.

As the juice of this plant is viscous, it is with difficulty dried; and rain, after it is mowed, hurts it greatly; insomuch, that in a few days the leaves become as white as paper: if the rain does not continue, it is best not to stir it; for the sun's heat immediately succeeding, the outside only of the swarths will be damaged; but if the rain continues, the method I have recommended in making hay must be followed. It is proper to observe, that in very hot weather it
must

must be housed before it is quite dry, or the greatest part of the leaves will drop off and be lost.

Some, in cocking Lucerne, or other hay, before it is well dried, place a faggot up right in the middle of each cock, that the inside of the heap may have a free air: others, when they house their Lucerne before it is quite dry, lay it in beds alternately, a bed of good dry straw, and a bed of Lucerne: the straw prevents the Lucerne from heating, and contracts a scent that makes it relished by horses, which are in winter very fond of it when mixed with Lucerne: Lucerne will not keep long in stacks in the open air, unless it be well thatched, because it does not settle close enough to keep out the water.

When the seed of Lucerne is to be sowed, the grass must be cut before it blossoms, the plants being at least three years old; and the second grass is left to bear the seed. When it is ripe, early in the morning before the dew is off, the tops of the plants where the pods are, must be cut off with a sickle, and put into cloths to be carried into the house, and they must be dried in the sun. These must afterwards be thrashed on the same cloths. The seed, which is small

small and slippery, is dressed by passing it through a fine screen; and it is then fanned. The remainder of the plant may be cut with a scythe; for though the fodder it makes is coarse, yet the cattle will eat a great deal of it. In saving the seed of this plant, one mowing is lost, besides the inferior quality and quantity of the fodder that has borne the seed.

Lucerne cultivated in this manner seldom holds good above eight or nine years, because the grass by degrees choaks the plants: the field must then be plowed; and the land being got into good tilth will bear several good crops of corn without the assistance of dung. This is the method proposed by M. Patullo, and is practised in many parts of the kingdom; but to keep land constantly in Lucerne, another method must be followed, and the New Husbandry come in aid. For this purpose a considerable space must be left betwixt the plants of Lucerne, that they may have room to extend their roots, and that the earth about them may from time to time be stirred, and the weeds and grass destroyed. This may be done in the following manner at a small expence.

1. The Lucerne must be sowed in single rows at three feet distance one from the other.
2. Every

2. Every time the Lucerne is cut, the intervals must be stirred with a cultivator or a shifting-ear plow, but without an earth-board; or even with a strong raker drawn by horses, like that which is used to stir garden-walks: as nothing more is required than to destroy the weeds, and give a passage to the moisture, these light stirrings are sufficient without turning the earth: besides, these stirrings are easily done, because the grass of the Lucerne being cut is not in the way.

3. Before the interval is stirred, some dung should be spread in it, but it must be well rotted: I have used pigeons dung with success.

4. Every two years a workman must look over the rows, and take up all the tufts of grass that the stirrings did not kill.

5. Instead of sowing the rows, they may be planted with three-year-old plants raised in a nursery: in that case little rills must be made at three feet distance, and the Lucerne set close in them. I have myself caused Lucerne plants to be set as big as my finger. The best time for doing this is in autumn; but it may also be done towards spring, if the weather is not too dry. These
large

large Lucerne plants, which I caused to be planted, yielded large crops of grass from the second year.

6. By the above method I have had fine Lucerne in land proper, it is true, for wheat, but dry, and which would not have borne Lucerne sowed in the common way : I have got in twenty thousand weight of Lucerne from an arpent ; and this same Lucerne, though planted many years, is still in perfection.

7. By this the advantage of having land proper for Lucerne is evident, as it yields in one year from three to six crops of an excellent hay, which agrees with all kinds of cattle, horses, oxen, cows, and sheep, which all eat it green and dry. I can from experience assert, that this fodder, cut green before the flowering, has recovered and fattened young horses, which were falling off their flesh without the cause being known ; and that cows fed with it give a large quantity of excellent milk : the only defect of this fodder is, that it is too nourishing for cattle, which are stuffed up by it. I know that three of my correspondents save the oats they used to give their horses, by giving them, instead of it, chopped Lucerne.

There

There are however horses which cannot be brought to feed on it.

Some oxen have died upon eating too much Lucerne; and others have grown fatter and stronger by eating it in proper quantities.

In some years, black caterpillars are seen in the Lucerne, which destroy the grass: in this case it must be cut as soon as possible: this destroys the insects, and the young grass that springs up is seldom infested with them.

SECT. II. *Of Saintfoin or Cock's-head, (Onobrychis Follis Viciæ Fructu echinato.)*

The roots of saintfoin are long, woody, black without, and white within. They are perennial, and terminate at the surface of the ground in a head, whence rise the leaves and several stalks, two feet or two and a half long, of a reddish colour, and bending on all sides. The leaves of saintfoin are conjugated, and consist of several small leaves or folioles, green above, and white and velvety beneath; they terminate in a point, and are fastened by pairs to a common foot-stalk, which terminates in a single small leaf or foliole. The branches are termi-

nated by spikes of legumenous red flowers, and sometimes white. When the bloom is past, the pistil becomes a small crested pod, rough, and containing a seed like a kidney.

There is another sort of Saintfoin that is smaller, and the seeds rougher: the large sort is best. There is also another large sort that comes from Spain, which has very red flowers: this yields a great deal of grass; but hard frosts kill it.

Saintfoin is a very vigorous plant, and yields a great deal of excellent fodder; not so much however as lucerne, because it can only be mowed twice a year; but it has the advantage of lucerne in not being so nice with respect to the soil: it thrives infinitely better in well-manured land, that has a good depth of soil; but it does not do amiss in russet lands, in which lucerne would soon perish: besides, every kind of grain grows well on land that has been in saintfoin.

Land intended for saintfoin has two or three plowings, that it may be well broke: the stones must be picked off the land, that it may be mowed close. About two thirds of the usual quantity of oats should be sowed with the saintfoin; and for an arpent of an hundred perches, each twenty-two feet, eight bushels

bushels, Paris measure, of seed should be used. The saintfoin mixed with the oats should be sowed in March, and covered with the harrow, as it would not grow if buried too deep. As saintfoin seed is often bad, a little of it should be sown on a plot for a trial. The oats must be cut very close to the ground : cattle should be kept out of the field ; and the second year the first crop is cut, which however is not so good as that of the third.

Saintfoin is cut sooner or later according to the use it is to be put to. If it is for sheep, it should be mowed as soon as it is in bloom ; if to feed oxen or cows, when the bloom is over ; and if for horses, it should be suffered to stand till the seed is partly formed in it, in which state the horses are very fond of it : finally, if it is intended to save the seed, either for sowing, or to give to horses, which like it better than oats, or to feed poultry, the saintfoin should not be cut till the greatest part of the seed is ripe. When the seed of saintfoin is to be saved, it should be mowed early in the morning, before the dew is off, or there will be a loss.

Saintfoin of three or four years old is generally cut when the bloom is going off. In the southern provinces they keep the cattle out of it, when they would have a second or third crop : but in the other parts of the kingdom, instead of taking a second crop, they turn their horned cattle into it, and the rather, because after the first crop of saintfoin, feed becomes scarce elsewhere.

Saintfoin has another advantage over lucerne, it being much easier mowed, because the sap, being less viscous, evaporates sooner; and it is of a greener colour when in a dark season it is dried by the wind. If rain falls after saintfoin is cut, the swarths must not be turned till the weather is fine : by this means it will still be green and good. There is another advantage in Saintfoin, which is, that though the weather should prove rainy, it may be mowed either before the bloom, whilst it is in bloom, when the bloom is past, or when the seed is ripe, as it is most likely that at some of these periods the weather will prove fine.

It may be imagined, without my saying it, that saintfoin which has perfected its seeds will yield but indifferent fodder: the leaves and flowers being fallen, nothing remains

mains but large stalks, which however horses will eat, the taste being agreeable to them.

Saintfoin when in good order yields a fodder excellent for all kinds of cattle, as has been already noticed, whether it is given green or dry: care however must be taken that they do not eat too much of it, particularly such as do not much work; for instance, most coach-horses.

Though this plant will grow in all sorts of land, except such as is marshy, yet it thrives much best in a good soil: it would therefore be of use to dung it now and then, as is directed for lucerne. The vigour of plants may be increased by allowing the roots a space of soil to extend in, and giving it frequent tillage: for this reason, when we would preserve it for more than nine years, it should be cultivated in rows, as we have directed for lucerne; with this difference however, that there may be two rows of saintfoin; and two stirrings to the intervals will be enough. But as saintfoin will thrive in any soil, and prepares land well for wheat or rye, it is seldom preserved long in the same field; therefore the common method of Husbandry is in general best for it. It is proper to observe, that two bushels of

saintfoin seed will do horses as much good as three of oats.

Saintfoin seed will keep very well when it is put into the barn unthrashed ; but when it is thrashed, it must be spread thin in the granary, and often turned, or it will be in danger of heating.

The use of this fodder is not so dangerous to horses as lucerne, or even clover.

SECT. III. *Trefoil or Clover*, (*Trifolium*.)

Many sorts of clover are found in the pastures, which differ only in the colour of the blossoms, and the form of the heads which enclose the seeds.

A sort of annual clover that grows high was formerly cultivated. M. Ray calls it *Trifolium capitulis dipsaci quorundam*. The only kind now raised is perennial, and is called *Trifolium pratense purpureum*, C. B. Its roots are large, long, and woody : the stalks of it are small, and grow to about one foot and a half high ; some of them are pretty erect ; others on the sides incline ; and some are a little velvety. The leaves are composed of three smaller ones, or folioles, which are sometimes round, at others oval : the
leaves

leaves are generally spotted with either a white or a brown spot, like a crescent. Its flowers approach to the legumenous flowers, and grow at the end of the stalks, where they resemble a short ear, or head: to these flowers succeed small round capsules, which contain the seeds. As it is one of the best grasses that grow in our pastures, the seed of it is often scattered in them; and when a field is to be laid down in pasture, clover is generally sown on it, which by degrees perishes, and the natural grass succeeds: but as clover seldom lasts in any quantity above three or four years on the same land, it is preferred to saintfoin and lucerne to be sown on fields that want rest, and are to bear corn again. The land is prepared for clover in the same manner as for lucerne: and if the land sown with clover is not to be laid down in pasture, it is plowed the fourth year; and first oats, and then wheat is sown; which is continued till the crops fail, after which it is again laid down in clover, of which hay may be made the second year. Clover does not thrive on poor lands: dung laid on clover is of advantage to the corn that will be sowed, when the lay is broke up.

In good soils and rainy seasons, clover may be cut three times ; but there are generally but two crops in a year, and even but one when the seed is to be saved, after which it is fed with cattle.

This fodder, green or dry, is very good for cattle : but as it is very nourishing, it must be given with discretion.

The great defect of clover is its being with difficulty made into hay ; for if it receives ever so little wet after it is cut, it grows black, and is of much less value.

Clover would be much more vigorous, if it was to be sown in rows, and the intervals stirred ; but this method is not to be recommended, as it remains so little time on the land, lucerne and saintfoin being much longer lived.

Clover seed is brought from Flanders, Burgundy, and Italy.

SECT. IV. *Of the several Kinds of Dog's-Grass cultivated to make artificial Pastures.*

The several kinds of dog's-grass compose the greatest part of the grass of natural pastures : it must not therefore appear surprising, that by sowing the seeds of these grasses

grasses we can procure artificial pastures that will yield good fodder for cattle. As the English were before-hand with us in this improvement, we have adopted the name which they give to the sorts of dog's-grass which they cultivate: thus the ray-grass, or rey-grass, of the English, is a dog's-grass which grows naturally with us; for, according to M. Ray and Miller, the true ray-grass is the *Gramen loliaceum angustiore folio & spicâ*, C. B. M. Ray adds, that in some countries they sow this dog's-grass to feed horses.

According to M. Miller, they grow a great deal of this dog's-grass in England, particularly on strong cold lands, where other grass would not thrive. One of its chief advantages is shooting early, so that cattle may be turned into these pastures soon in the spring.

To make the most of this grass it must be cut early, before the pipes are hardened; otherwise the ear falls, and the stalk becomes so harsh that the cattle will not eat it. This plant soon sprouts again, and makes tolerable good hay if it is often mowed, and always before the seed is ripe.

As

As the seed of this plant may be had from England, it is proper to observe, that it must not be confounded with what the English call rye-grass: they call by this name two sorts of dog's-grass: one, which grows on walls, and by highway-fides, is the *Gramen bordeaceum minus* & *vulgare*, C. B. Ray observes, that the ear of this dog's-grass rather resembles rye than barley. The other kind of rye-grass is the *Gramen spicatum minus secalinum*, I. R. H. Ray adds, that it grows in the meadows. M. Vaillant has given its form in the *Bot. Paris. tab. 17*. Some English writers say this plant is worth cultivating; others assert it to be of no service even to natural pastures.

I must also notice, that they sent me from England, under the name of ray-grass, the *Gramen avenaceum elatius, jubâ longâ splendente*, Ray. This induces me to think, that they cultivate in England several sorts of dog's-grass, which they call indifferently ray-grass.

The same thing happened in the seed they sent me from Geneva and Lyons under the name of *Fromental*; for it turned out to be a mixture of five or six sorts of dog's-grass; and in fact, why should not we, besides

sides those I have mentioned, cultivate the *Gramen avenaceum paniculâ flavescente, locustis parvis*, (Ray) or the *Gramen pratense paniculatum majus angustiore aut latiore folio*, C. B.?

I have rather enlarged on the different sorts of dog's-grass, because a lover of Husbandry, who had from England a different kind of dog's-grass from what I had from the same place, has taxed me with inaccuracy.

These kinds of dog's-grass may be sown either in spring or autumn. I caused the seed I received from England to be sowed in rich moist land: it grew to near five feet in height. I do not value this hay so much as lucerne, saintfoin, or clover; yet, if it is sown with clover, it makes very good hay.

Unfortunately it happens, that land laid down in ray-grass, or fromental, are not, when broke up, immediately fit to bear wheat, like such as have been in saintfoin, lucerne, &c.

SECT. V. *Of Furz, Whins, or Gorse ;*
(Genista Spartium majus, Aculeis brevibus
et longioribus, Inst.)

Furz is easily propagated by seed. They sow entire fields of it in Normandy, Bretagne, and a part of Poitou; and the same method is followed which we have directed for saintfoin. But it is only in rich soils that it grows strong: it has grown best with me in good loams; and some sown in the good wheat-lands of Beauffe did not succeed.

Though this plant is full of prickles, yet the herdsmen of Aunis, Bretagne, &c. employ themselves in the day time in cutting the young shoots of it, and at night carry the bundles into the house: they break the prickles by beating them with large mallets on blocks of wood; and in this state they give it to the cattle, which eat it heartily. This is very wholesome food, but the trouble of gathering it and breaking the prickles is no small inconvenience. The herdsmen of Bretagne are accustomed to this work; and as they sow furz in the fences, and even in well-manured land, to supply the want of wood,

wood, this plant is an excellent resource in dry years, when the pastures afford but little grass : by means of it they have in winter green fodder, for they never dry it : they shear this shrub, which is green in winter, and give it immediately to the cattle. In woody countries this plant sows itself, and spreads over all the uncultivated land ; but the plants that grow thus uncultivated are dwarfed, hard, dry, and not so good for cattle as such as are sown in good land.

Furz is in full bloom in May ; but as there is then plenty of pasture, they do not give it to cattle. At the beginning of winter, when the grass fails, they cut the young shoots of this plant to supply the place of fodder : the first cutting is in December ; but in good soils it shoots again, and may be continued cutting without permitting to blossom, because the prickles are then tender, and a few strokes of the mallet are sufficient to prepare it as food for horses or other cattle, which derive good nourishment from it. In countries where they have mills, to grind apples, or seeds from which oils are expressed, they will serve to grind the furz with greater expedition.

In

In order to save furz seed, when it is ripe, the plants must be sheared, and the part cut off must be dried in the shade, and afterwards thrashed on cloths, and dressed.

Land that has been sown with furz, when all the plants are pulled up, is in a good condition to bear corn.



CHAP. III.

Of several Kinds of Herbage which serve as Food for Cattle, either green or dry.

BESIDES the perennial plants I have mentioned, several annuals are cultivated chiefly as food for cattle. These are spurrey, rye, bear, maiz, vetches, and grey peas.

SECT. I. *Of Spurrey, (Alfine Spergula dicta major, C. B.)*

This plant, which grows naturally about Paris, particularly in the woods, rises to about a foot in height: it is annual: several stalks rise from the root, some of which are straight, others on the sides are bent: these stalks are jointed, and from

every joint proceed several verticillous leaves; that is, they encircle the stalks: these leaves are long, narrow, and very soft; and from these joints proceed also the branches which spread on all sides: the upper part of the stalk, as well as the leaves, is covered with a fine down, soft to the touch.

The empalement supports five white petals of a rose shape: within are ten stamina with yellow summits: in the middle is the pointal, comprehending the embryo and five styles: the embryo becomes an oval fruit, having five capsules, which contain the small seeds.

This plant is not nice with regard to soil, provided it is a little moist.

Spurrey seed is sown in May, when the seed of it is to be sowed, or it is to be cut for hay: but hay is seldom made of it: it is more usual to sow it on the wheat stubbles immediately after harvest.

When spurrey is sown in May, the land must be first well plowed; and after it is harrowed the seed is spread, in the proportion of at least one pound to a square perch, of twenty-two feet: the back of the harrow is then passed over the field: as the seed is small, this is sufficient to cover it.

When

When the seed is ripe, but before the capsules open, the spurrey is mowed : it must be housed before it is quite dry, lest the seed should shed. It is then thrashed, and when the seed is gathered up, the remainder is given to the cattle in the winter.

When spurrey is to be sown in July, immediately after harvest they give the land a plowing, and the seed is sown in the proportion already mentioned. When the plant is grown to a certain height, they pull it up, and give it green to the cattle, or sometimes feed it on the spot : the pasture is very nourishing ; but it should be speedily fed off, for the frost affects it greatly.

Though spurrey seed should be several years old, it sprouts very well.

SECT. II. *Of Rye.*

We have already treated of the culture of rye, when it is sown for the sake of the grain ; but when a field of rye is intended to soil horses withal, or to be given green to oxen or cows, it is mowed in April, when it begins to spindle. It will sprout again the same year ; and if the season proves any
 thing

thing moist, it may be mowed three times the first year, and twice the year following: it yields a great quantity of fodder. M. Delu has had five such mowings in two years. This fodder is much to be preferred to the dog's-grasses we have mentioned above.

SECT. III. *Of Bear, or Square Barley.*

Near great towns this grain is usually sown, to be cut green, in order to foil horses, or to feed she-afles that are milked for sick people. This barley would sprout again; but as it is generally cut very early, the field is for the most part plowed directly, to sow peas, or kidney-beans.

It is proper to be observed, that green wheat, given in too great quantities to cows, commonly disorders them.

SECT. IV. *Of Maiz.*

We have already treated at large of the culture of maiz, when it is sown for the sake of the grain; but if it is sown merely for green fodder, after the land has been

well plowed and manured, it must be spread with a broad cast, very thick, and immediately plowed in; and when the maiz, which in this method could never spindle, is risen to the height of two feet, they cut it, and give it green to the cattle; or else dry it for keeping: it furnishes a winter fodder, which is at all times very wholesome and relishing to cattle.

SECT. V. *Of the Vetch*, (*Vicia vulgaris sativa* Semine nigro, C. B.)

The vetch rises in several stalks, to the height of one foot and a half, or two feet: these stalks are angular, velvety, and hollow. The leaves are conjugated, and consist of ten or twelve oblong small leaves, or folioles, placed in pairs on a filament, which terminates in a tendril. The flower of the vetch is leguminous, sometimes blue, at others purple: the pointal becomes a pod, composed of two parts, and within is a row of round black seeds.

In the southern provinces of the kingdom they sow the vetch before winter; for this plant bears the frost pretty well: yet, in our provinces, they sow it

on the spring-corn lands, which have been winter-fallowed, and have had a second plowing in February or March. The vetches are sown on the fallow, in the proportion of eleven or twelve bushels, Paris measure, on an arpent of one hundred perches, of twenty-two feet each: the stones should be picked off the field, and it should be rolled, to break the clods and lay it level, that it may be mowed close to the ground.

Vetches grow high, and are vigorous, in proportion to the goodness of the soil; but in ordinary land, if the season is not too dry, they will yield a fodder.

When there is a great scarcity of fodder, the vetches are cut green, and given to oxen and cows: but this fodder is generally saved for winter; and to have it in full perfection, it should not be cut till the grain is formed, without being ripe: the grain induces the cattle to eat the straw with it. If the seed is to be saved, either for sowing, for pigeons, or to mix with oats for horses, the plant must be suffered to remain till the seed is ripe; but the fodder is then of little worth. It is astonishing to see

the quantity of fodder that is to be procured from a piece of vetches when the soil is good.

When vetches are sown to feed oxen, they are generally mixed with oats, and they are together cut green before the seed is ripe.

Vetches are made into hay like other herbage: it must be housed very dry, or it will spoil in the barn or stack.

SECT. VI. *Of the Field-Pea, (Pisum vulgare parvum arvense, J. B.)*

Many different kinds of peas are cultivated as well in gardens as in fields, to be eaten green or dry; but these are not now in question: we mean in this place a kind with violet-coloured blossoms, and smaller pods than such as are generally raised for the table. These peas are small, are of a greyish white, and have hence been sometimes called grey peas.

As the culture and use of these peas no ways differ from what has been said of vetches, to enlarge on the subject were needless.

SECT.

SECT. VII. *Of the Horse-Bean, (Faba minor, five equina, C. B.)*

This plant has strong upright stalks, about a foot and a half, or two feet high: they are square and fistulous, and divide at the top into several branches, which bear the flowers and fruit: the leaves are composed of oval, oblongated, rounded, fleshy, succulent, small leaves or folioles; and the filament which supports them terminates in a point: the flowers are leguminous, elongated, and for the most part white with black spots: the pointal becomes a green, fleshy, inflated pod, which contains the beans that are flatted. They are sowed in spring, and gathered when they are ripe; they are then dried and given to horses, which are very fond of them: this pulse serves them instead of oats: the stalks are good for nothing but to burn, or to throw on the dunghill.

SECT. VIII. *Of that which is called Green Fodder, (Fourrage verd) for the Winter.*

Some farmers, with a view of providing for their sheep and lambs, pasture in

which they may turn them in winter, from among the fields they are about to fallow, pitch on a sloped piece of land open to the east or south, but sheltered by a grove from the north and north-easterly winds. They turn in the stubble as soon as possible, and sow it very thick with all sorts of screenings and refuse corn, mixed with seeds of weeds. They do not turn in their flocks till the middle of January or February, that the herbage may have time to grow. When they have no other pasture, they turn their flocks in; but when pasture becomes more plentiful, they take them out, and plow up the field, that it may be brought into proper order by seed-time. But as the sheep cannot be turned in when it snows, and get no good from it in frost, and as the farmer uses the off corn that should feed his poultry, I cannot think this an advantageous method: it would be much better to save a piece of old lucerne to turn his flocks in.

SECT. IX. *Of Cabbages.*

Many kinds of cabbages are cultivated, of which the heart or tender leaves are eaten, and the large lower leaves given

ven to cattle. The sorts most proper for this use are the *Brassica fimbriata maxima*, Inst. and the *Brassica arborea seu procerior ramosa*, Mor. The seed is sown in a bed in the kitchen garden: at a proper time they are transplanted by hand into a good soil well dunged, and plowed as deep as possible: two feet distance at least should be left betwixt the plants, and in the course of the summer they should have two slight stirrings. In a rainy year these cabbages bear a great quantity of leaves for the cows, even in winter time. These sorts of cabbages live several years.

SECT. XI. *Of the Leaves of Trees.*

On the borders of forests, and in woodland countries, they carefully gather up the leaves of all kinds of trees as soon as they begin to fall, or else pluck them from the trees just before they are ready to drop: they are then dried and kept to feed cows and weathers in the winter.

It is unnecessary to mention several plants cultivated for particular purposes, the leaves and stalks of which are given to the cattle. Maddar, for instance, which

is of such use in dying, produces stalks and leaves which cows and oxen eat very well; but as the chief intention of this culture is to procure an excellent dye, this fodder should only be looked on as an accidental acquisition. They also give saffron-stalks in the spring to cows; but this herb gives the butter a bad taste.



C H A P. IV.

Of Roots cultivated as Food for Cattle.

THE winter-frosts destroy almost all the grass that covers the earth; and that which escapes, grows so slowly, that it is necessary to give cattle dry fodder. Yet there are some cattle which like green and succulent plants much better. The several kinds of green fodder I have mentioned are a tolerable resource; that of bruised furz something better: but I know of nothing so proper to supply the place of green herbs, as certain roots which furnish cattle with food in winter. They are of several kinds, viz.

po-

potatoes, Jerufalem artichokes, navews or French turnips, turnips, radishes, and carrots. As these roots are all cultivated in the same manner, I shall divide this chapter into three sections, in one of which I shall treat of potatoes, in the next of Jerufalem artichokes, (*topinambours*) and in the third of navews, turnips, radishes, and other roots.

SECT. I. *Of the Potato*, (*Solanum tuberosum esculentum*, C. B.)

This plant has several stalks, two or three feet high, as big as one's finger, angular, and a little hairy: they bend on all sides, and are divided into several branches, on which are the leaves, which are conjugated, and consist of several small leaves or folioles of different sizes: from the leaves placed at the extremity of these branches, (which is of a dull green colour) proceed little bunches of flowers, consisting of an empalement or flower-cup, which is divided into five parts; of a petal, which resembles a star, of a grey violet colour: the stamina, which are yellow and meet in
the

the centre, form, by their junction, a kind of clove: the pointal becomes a large fleshy berry, which grows yellow as it ripens, and encloses a number of seeds. This plant produces in the earth thirty or forty large tuberous roots, in some sort resembling a veal-kidney. On the surface of these roots are holes, from whence proceed the stems and fibrous roots which feed the plant, and give a fresh supply of roots. Some of these potatoes are red, others almost white.

The Irish are so fond of potatoes, that they spare no pains to have plenty of them.

They plow and harrow their field, and after having made holes one foot deep, two feet square, and three feet one from the other, they fill them with dung, which they tread down: on this dung they put one potato in each hole, which they cover with the earth that came out of it; as fast as the potatoes grow, they earth them up with the mould that is within reach: this they do twice, observing not to draw out the stalks that lie on the surface of the ground. By this means they have sometimes eight hundred, or nine hundred

dred for one. As this method consumes a great deal of dung, it cannot be profitable but near great towns. The following is the ordinary method of cultivating this plant.

It is not necessary to mention the nature of the soil, because it thrives pretty well in any, with this difference however, that the crop is in proportion to the goodness or badness of the land.

The field intended for potatoes, being well plowed, about February, or the beginning of March, trenches five or six inches wide are made over the whole surface of it: the depth of them is proportioned to that of the soil.

In these trenches are put as much dung as will lie in them; which, besides increasing the crop of potatoes, prepares the land for the wheat that is to succeed.

Small potatoes are put whole into the furrows, at two feet distance one from the other; the large ones are cut in slices, for it is sufficient if each slice has one or two eyes: in shallow soils the potatoes are planted at a greater distance, that their roots may have room to spread, and button.

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The potatoes and dung are immediately covered with the earth that came out of the trenches: when the stalks are grown to the height of five or six inches, the earth of the intervals betwixt the rows is dug and spread on the plants to earth them up: this is done a second time, when they are about twelve or fifteen inches high, observing, not to cover the stalks that lie on the surface of the ground: the greater the depth of the soil is, the larger will be the crop.

When the potatoes are ripe, which is known by the stalks beginning to wither, the earth of the beds is turned over with a fork, and the potatoes, large and small, carefully gathered up; for if any were left, they would sprout, and be as bad as weeds.

This plant does not impoverish land intended for wheat; on the contrary, the tillage which the culture of it requires, and the manure without which it thrives but badly, have a great influence on the succeeding crop.

Some people, to spare the trouble of plowing the field when the potatoes are off, sow their wheat on the land before they

they are dug up. By this method the seed is indeed sufficiently covered; but it is scarcely ever regularly disposed. The common method is to be preferred.

Much trouble might be saved by cultivating this plant in the new way. For this purpose, after the land has been dunged and plowed three times, trenches may be formed by the plow, by making deep furrows, and passing the plow twice in each furrow: the potatoes are to be put at the bottom of the trenches, and covered by hand with a little of the side earth. When the stalks are six or seven inches high, the trench is to be filled with a plow, by passing on the right and left sides; this earths the potatoes up for the first time: a ridge will remain in the middle of the intervals: about five or six weeks afterwards, this ridge or balk is to be split, and a very deep furrow is cut to fill the side furrow, and this earth is afterwards turned on the rows. If the land is light and sandy, an arpent may be done in this manner, in three or four hours, with a single horse.

Po-

Potatoes are planted about the end of April, or the beginning of May; and they are generally turned up in October following. They should be kept in a cellar, and preserved from frost. By this method M. de Villiers-en-lieu has had three hundred and thirty, and three hundred and forty bushels (French) on a journal of land; and M. de Chezane has had four hundred bushels (French) on an arpent.

This root encreases prodigiously, and is very proper for feeding and fattening cattle. They are boiled in water, and require but little boiling, though they have been kept two months in the store. Cattle eat them raw; but for the table they are wholesomer boiled.

I earnestly recommend the culture of this plant to husbandmen, as it is not only excellent for cattle, but good food for men in years of scarcity. After a little use, the taste becomes at least as agreeable as turnips, and particularly if the potatoes are boiled with bacon, and salt pork. The consumption of them in the English islands is astonishing; and many are eat in some of the French pro-

provinces. They yield a very white meal, which mixed with wheat-meal makes good bread. I have eat of it when there was no more wheat-meal in it than was necessary to make it rise.

SECT. II. *Of the Jerusalem Artichoke, Topinambour;* (*Helianthemum tuberosum indicum, the Corona Solis tuberosa Radice, Inst.*)

This plant puts forth a stalk as big as the handle of a pruning-knife: it is erect, and rises to the height of five or six feet: the bark is green and rough: to different parts of this stem are fixed leaves which are broad at the base, and terminate in a point: they are of a deep green, and rough: at the top of the stem are twigs, or small branches, which bear flowers radiated like the garden sunflower, but smaller; and under the surface of the earth, at the foot of the plant, are large green tubercles of an irregular form.

The culture of this plant is the same as that of potatoes. The Jerusalem artichokes are drawn at the beginning of the

the winter, or whenever it is necessary to give them to the cattle: pigs are particularly fond of them. Some people eat them, and dress them like turnips.

SECT. III. *Of the Navew, or French Turnip, (Napus) of Turnips, (Rapa) and of Radishes, (Raphanus.)*

It is unnecessary to mention the small navew, used in the kitchen: we mean only to treat of such as are given to cattle. These may be reduced to three kinds: 1. The large navew, *Napus sativa, altera maxima radice*, H. R. P. Though this navew is raised for the table, it is also given to cattle when raised in any quantity.

2. *Rapa rotunda radice, aut candida, aut obscure nigricante, aut viridi, aut punicea, aut flavescente*, C. B. This is the English turnip, or the *rabiole* of the Limousin, Poitou, Bretagne, &c. Though this root is principally raised for cattle, it is nevertheless very good eating at the table. The sort most valued in England is the red Scotch turnip; but there is very little difference in their goodness.

3. Ra-

3. *Rapa sativa oblonga, five fœmina*,
C. B. This kind, which is the Limou-
sin turnip, is cultivated like the former,
and applied to the same uses.

All these plants put forth large ob-
long leaves, more or less indented, some-
times even as far as the middle fibre:
they are of a deep green colour, and
rough; have a pungent taste, and incline
towards the ground. In the midst of
these leaves arise stalks, four or five feet
long, divided into a number of branches,
which bear many flowers, consisting of
four leaves, in form of a cross, issuing
from an empalement supported by a long
slender footstalk: the pointal becomes a
long slender pod, enclosing the seeds, which
are nearly round: the roots, which are
the useful part of this plant, are tuber-
ous and fleshy, and are variously formed.
The root of the great navew is near co-
nical, and terminates in a point in the
earth. The large long turnip, of the Li-
mousin, is almost cylindrical in a part of
its length, and terminates in a cone at
bottom: this turnip is much larger than
the navew above-mentioned, many weigh-
ing above twenty pounds. The *rabioule*,
or turnip, has its root nearly spherical

and compressed; that is, it is much broader than thick: this large apple, which is almost above the surface of the earth, pushes down a tap-root as big as one's finger, which supplies it with food. I have pulled turnips of this sort, which have been above nine inches diameter.

These roots are all fond of a light, deep, sandy soil: to have them large, the land must have been well plowed and manured; for if the dung was only laid on when the turnips or navews were sowed, it would attract the insects, and endanger the crop.

The land must be prepared by three plowings: the first is given before the winter, when the land is laid in ridges, that it may be broke by the frost; the next is given when the frosts are over, and the land is a little dry; the third plowing is before sowing, that is, in June. But this is only done when land is purposely prepared for turnips; the practice is very different when they are sown after corn, hemp, or flax.

These plowings should be deep, that the roots may penetrate into the earth. I have had turnips of an amazing size,
by

by causing the earth to be dug three feet deep. I do not however recommend this practice, being too expensive; but it proves the benefit of deep plowing, and of how much consequence it is to stir strong land frequently. Navews thrive pretty well in dry chalky soils.

Navews are commonly sown in June, and as near as possible just before rain. Nothing is more uncertain than the coming-up of navews and turnips: they are sometimes obliged to be sown two or three times. When they come up in spots, the vacant spaces must be sowed over again, and the seed covered with a rake. But if, notwithstanding these precautions, they do not prosper, either from a defect in the seed, or because the caterpillars destroy the young plants, it is best to sow vetches, to cut green, which makes good hay; or else let the land lie fallow till autumn, when it may be plowed, and sown with wheat.

The seed of these plants should not be covered with above an inch of earth, particularly the *rabioule*, which, to succeed well, should have its apple out of the ground.

When the leaves begin to cover the land, if the turnips are of any size, part of them are drawn and given to the cattle; then the whole field is hoed. The crop is by this means thinned; and this is necessary, as they should stand at least a foot asunder.

In wet summers, when weeds get a-head, they should have a second hoeing.

In October these navews are drawn and put in cellars, to be kept till they are wanted for the cattle; and it is generally in winter, when for want of grass the cattle are obliged to be foddered: they cut these turnips before they give them to oxen, cows, or hogs; sheep can dispense with them whole very well. Some farmers boil the turnips, which is soon done; others give them raw, and after a little time the cattle eat them. They may also be drawn and eat in the field: but, besides the loss, it would be eating them when other fodder was to be had; for one of the great benefits of this root is, to supply in winter the want of green fodder. It must indeed be allowed, that by feeding them on the land, the field would be well manured, not only by the dung

dung of the cattle, but by the refuse of the roots.

These kinds of navews may be sown on hemp and flax ground, at the time they are pulled; there is then no occasion to cover the seed. They may be sown also on stubbles, after harvest: for this purpose a slight plowing should be given, and the seed harrowed in, being sowed very thin. By these methods small navews fit for the table may be had before winter.

Latter turnips are also sowed, merely for the sake of giving the leaves to the cattle: for this purpose the seed is sowed very thick, and the leaves are given to them when they are a foot high.

But to return to the culture of the large turnips.

When the leaves are about as broad as a shilling, they should be thinned by hand, or with a hoe, to about seven or eight inches from each other. By using the hoe the weeds will be cut up, and the young plants receive a slight stirring.

When the turnips are as big as apples, they should be again thinned to about twelve or fourteen inches asunder. The

turnips that are drawn may either be given to the cattle, or used for the table.

These roots require no more care till they have attained their natural growth: then, before the frost sets in, the leaves must be given to the cattle, and the roots, being drawn, must be carefully preserved on hurdles, in a dry place, a layer of turnips, and a layer of dry sand, and in winter be given to the cattle. We have observed above, that some farmers feed their turnips on the land, where the cattle, first eating the leaves, afterwards feed on the roots. In this case, the land should be hoed, to draw up the remainder of the root, which the cattle will still feed on. By this method the land is well manured; but then the farmer deprives himself of a green fodder, which would be of service in winter, when he has nothing but dry fodder to give his weathers and oxen.

To fatten oxen, they should have turnips night and morning, and at other times, their ordinary food. The turnips whet their appetites in such a manner, that an ox, of five or six hundred pounds weight, will in twenty-four hours eat two hundred pounds weight of turnips, and a
truss

truffs of hay: and if he had only hay, he would scarcely eat two trusses. An arpent of land yields more than seventy thousand pounds weight of turnips; so that it will maintain an ox three hundred and fifty days. If the cattle are in good order when they are put to turnips, they will fatten in three months.

When the turnips are off the land, after once plowing, wheat may be sowed; or, waiting till spring, barley, with either clover or lucerne: when the barley is mowed, it will become a good artificial pasture. To procure turnip seed, after the frosts are over in the spring, some of the finest roots must be planted by themselves: they will yield a great deal of seed.

I shall not here say any thing of the culture of rape, of which oil is made, as I am now treating of articles that will serve as food for cattle.

For the benefit of such as are willing to raise turnips in the new way of husbandry, I shall give them M. de Chateauvieux's method. On a piece of ground thirty-six fathom square, or that contains

one thousand two hundred and ninety-six superficial square fathoms, fifty-four beds, each four feet wide, are formed: these beds, being two hundred and sixteen feet long, will bear at least two hundred and sixteen turnips; for, on account of the width of the intervals, they may be closer planted. As the field is divided into fifty-four beds, eleven thousand six hundred and sixty-four turnips may be drawn. And suppose, one with another, they weigh six pounds each, which is too little, the produce will be sixty-nine thousand nine hundred and eighty-four pounds: no inconsiderable crop. By this means, food is procured for fattening oxen, cows, weathers, pigs, and even poultry. And if, by chance, corn is scarce, what an excellent food is here for the poor! Thus, for many reasons, every good husbandman should grow potatoes, turnips, &c. Several kinds of radishes may also be raised in the above method, as the white or black radish, (*Raphanus niger*, C. B.) the large radish, (*Raphanus major orbicularis* & *rotundus*, C. B.) The most striking difference betwixt radishes and turnips, or navews, is, that the seeds of radishes are inclosed in inflated pods

pods terminating in a point, not unlike little horns.

Several sorts of carrots are also in some provinces raised for the use of cattle, (*Daucus sativus radice luteâ, aut albâ, aut auran-
tîi coloris*, Inst.) This plant, very different from the foregoing, bears its leaves and seed in an umbrella fashion: the leaves are very deeply indented: the roots of carrots grow very large and long with good tillage; they are very good food, either for men or cattle. Their culture is the same as that of turnips,

B O O K X.

*Of the Culture of several Kinds of Plants, in
the New Husbandry.*

THE New Husbandry may not only be applied to the several sorts of grain and plants that form artificial pastures, but also to kitchen-garden plants, flax, hemp, teazle, &c.



C H A P. I.

Of Pulse, and some Kitchen-Garden Plants.

AS we have already treated at large, in the preceding book, the culture of navews, turnips, radishes, and carrots, it is unnecessary to repeat it in this place: it is sufficient to remark, for instance, that what is said of the culture of the *rabioules* may be applied to the small turnips that are used for the table. The small radish, which is called at Paris *la rave corail*, (coral radish) requires indeed some care, when a succession of them is required in spring,

spring, summer, and autumn: but this only respects kitchen-gardens, which are not now in question. The same reason prevents me from enlarging on the old or new culture of peas, lentils, beans, cabbages, and other plants, which I have already treated of in the section of artificial pastures. I shall content myself with relating the result of some experiments, which will prove what I have advanced in the last book.

SECT. I. *Of Cabbages.*

I have already observed, that I have raised, in the open field, and on plowed land, large cabbages, which have yielded a large produce, as well for the cattle as for the table. M. de Chateauvieux, having prepared a field, and laid it out in beds, as for wheat, caused it to be planted with white cabbages in September. The ninth of March following, the field had a stirring; the twenty-fifth of April, a second; a third, on the third of June; and a fourth, on the twentieth of July; the last stirring with the hand-hoes, the plants having spread

spread too much to admit of the cultivator.

These cabbages, which had never been watered, except when they were first planted, preserved their verdure during the whole summer, most of them weighed fifteen or eighteen pounds; and they were much more vigorous than those that were carefully raised in the kitchen-garden.

SECT. II. *Of various Roots.*

I caused a field to be plowed as deep as possible: it was then sowed in rows with carrots, red-beets, and falfify; some of them were drawn to thin the rows. These roots, which were cultivated with the plow, grew surprizingly.

M. de Chateaufvieux having got some beds ready before winter, the hard frosts that succeeded, so mellowed the land, that, without plowing it, he sowed on the fallow single rows of red-beets, carrots, and scorzonera. These plants came up well: they were thinned in such a manner, that the beets were near fourteen inches asunder; the carrots, seven or eight; and the scor-

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scorzonera, four or five inches. The intervals were hoed the fifteenth of June, the 27th of July, and the sixth of September. These plants grew to an amazing size: the beets were five or six inches diameter; the carrots, from two to four inches diameter, and from twenty to twenty-five inches long: some of them weighed thirty-five ounces: the scorzonera was infested by caterpillars, and did not succeed.

M. de Chateaufieux, encouraged by this success, extended this culture to colliflowers, cardoons, strawberry-plants, artichokes and asparagus; and the success he had, answered his expectations.

M. Eyma had, from a piece of land of indifferent quality, which had not been manured, but was tilled by hand, according to the New Husbandry, four good crops of kidney-beans, and two of beans, in the space of four years.

In fine, (for we must not enlarge too much) M. de Trolly, near Epernay; M. Aimen, at Castillon-sur-Dordogne; M. Barbuade-Juranvigny, at Nogent-sur-Seine; M. de Villiers-en-Lieu, near Saint-Dizier; and several other lovers of husbandry, whose lands are situated in various provinces,

vinces, have had great success in raising, according to the new principles, beans, kidney-beans, lentils, celery, colliflowers, and various kind of roots.



CHAP. II.

Of Flax, (Linum sativum, Tournef.)

THE stem of this plant rises erect to about two feet high: it is round, hollow, and divided a-top into several branches: its leaves are elongated, narrow-pointed, and are alternately placed along the stalks and branches: the flowers are at the end of the branches: they consist of five blue petals arising from an empalement consisting of several leaves: the pointal becomes a capsule almost round, and terminating in a point: this capsule is divided within into ten cells, in each of which is enclosed a bright, slippery, elongated seed.

SECT. I. *Of the Culture of Flax.*

Land destined for flax should be tractable, not too light, and have a moist bottom: for instance, a soil in which water is met with

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with at a foot and a half, or two feet deep. Fine flax is however often bred on high lands, provided they are well manured, and the season does not prove too dry.

The memoirs of the Dublin society say with reason, that a clayey soil yields better flax seed, or linseed, than such as is lighter; and that, in such soils, as good seed may be grown, as can be got from Riga or Zealand. For my part, I cannot think that strong lands can produce as fine flax as those above mentioned.

In the southern provinces they sow a part of their flax in September and October: this is in the ground all the winter. The other flax is sown in the spring: this yields less flax; but, as it is finer, it is more valued than that sown in autumn. I am of opinion, that flax sown in autumn yields better seed than that sown in spring. But be it as it may, as in the interior parts of the kingdom they would, when the weather was hard, run the risk of losing their seed-time, almost all the flax is sowed in March, or the beginning of April. It is of this spring flax we shall more particularly treat.

It may be laid down as a general maxim, that land intended for flax ought to be extremely well stirred, and meliorated by plowings and manures.

manures. When a pasture is broke up for raising flax, it should be plowed for eighteen months, or two years, before the linseed is sown. To defray the expence of this tillage, some crops may be got off the land, particularly such as do not occupy it long, and that require culture whilst they grow, as madder, maiz, beans, turnips, &c. because this repeated tillage makes the land very fine, and kills the weeds, which are great enemies to flax. If the land destined for flax is strong, great care should be taken not to till it in wet weather, lest it be kneaded.

As we have said that flax land should be well manured, it must be concluded, that when it is made to bear other crops, it should be plentifully dunged, to mellow and enrich it, and prevent its being impoverished.

If the land intended for flax has been long in tillage, it should before winter have a deep plowing, and be laid in high ridges, that the earth may be penetrated and mellowed by the frost.

In February, if the land is not wet, some very rotten dung should be laid in the furrows, and immediately covered with the plow.

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In March or April, according to the climate, another plowing must be given to lay the land level ; the clods must be broke with mallets ; and when the seed is sown, it must be covered with the hoe, burying it no more than one inch deep. If the soil is damp, and has not much substance, some pigeons dung may be sown with the seed, which agrees very well with this plant, if the soil be not very light and too dry. If the land is wet, it should be laid out in beds, thirty or forty feet wide, separated by deep trenches to drain off the water, and convey it into the side ditches.

Most of our linseed comes from the north; that is, from Riga and Zealand: but very good linseed may be grown by conforming to the directions contained in this section.

Linseed is reckoned good when it is large, oily, heavy, and of a bright brown colour. To know whether it is oily, some grains of it should be put in a red-hot fire-shovel, where it will crackle and burn briskly. If it is heavy, it will sink to the bottom of water. And to know if the seed is new, a certain number of seeds should be sown on a bed, and observation made whether they all come up.

When the seed is known to be good, a larger or a smaller quantity is to be sown according to what is intended; whether to have a quantity of good linseed for sowing, or for making oil; or to have fine, soft, and even threads of flax for spinning. In the last case, one hundred and eighty-eight, or one hundred and ninety pounds of linseed are sown on an arpent of one hundred square perches, each twenty-two feet. If it is sown on a strong soil for a good crop of linseed, one hundred and fifty pounds will be sufficient for an arpent: a great deal of seed will by this means be got; but the stalks will be woody, and the threads harsh and coarse.

Some with the linseed sow a few carrots or turnips; others, that have a mind to lay down their land in pasture, sow clover with it. These plants come up but weakly with the flax, and do not injure it; but when the flax is pulled, they grow apace, to the great benefit of the owner.

Flax, when about three or four inches high, is sometimes damaged by insects. They may, it is said, be killed by strewing the field lightly with ashes: it is certain the ashes will be of service to the flax, though they should not destroy the insects.

If

If any weeds appear, which is generally the case, the field must be cleared of them; and, that the flax may receive as little damage as possible, the weeders should work bare-footed.

The finest flax is most liable to be laid, particularly in countries subject to tempests. To guard against this accident, it has been recommended to fix, at equal distances over the field, stakes, and to tie poles to them; but this method appears troublesome.

SECT. II. *Of pulling the Flax.*

Various are the opinions about the time in which flax should be pulled: some say, that it is best to do it whilst it is green, to have fine soft threads: these pull their flax before the seed is quite formed; and being persuaded, that green flax produces the finest threads, they advise that the plants which have not seeded, and such as have not perfected their seed, should be selected from the rest, in order to get the finest flax. Without determining the question, I shall only observe, that this method is so far of use, as green flax is sooner rated than that which is very ripe.

Others, on the contrary, imagine that flax should not be pulled till some of the capsules, which enclose the seed, open; and they maintain that green flax yields too weak a thread, running into hards in hackling. It is very certain, that the threads of thorough ripe flax are always harsh and woody, that it brakes with difficulty, and never bleaches well. It is therefore certainly best in this case, as in many others, to avoid extremes; and we think it best to pull flax when the stalks assume a bright yellow, when they shed their leaves, and the seeds grow brown in their capsules.

When the flax is judged to be ripe, it is pulled by women: some of them pull it with both hands, laying it down in the field: others with their right hand pull a few stalks of flax, which they gather in handfuls in their left; they pick out all the weeds they meet with; they shake the earth from the roots, separate the green stalks, and lay them all even. Though this last method of pulling flax takes up most time, it is certainly the best.

In Holland, as fast as they pull the flax, they lay it in heaps, about one foot and a half thick; they turn the heads of the plants
to

to the south, that the sun may dry the seed; in about fifteen or eighteen days they make them into bundles, in order to be housed. The most usual way in France is, to bind every handful as fast as it is pulled: the band is made of flax, and is placed near the head: the roots are spread out, in order to set the flax upright. In this way, the sun and wind acting freely on every part of the flax, it is soon dried; and if rain falls, it takes little damage: it is dry in two or three days, which is a great advantage, as flax ought to be rated whilst the water is warm.

SECT. III. *Of the Method of separating the Seed, and rating Flax.*

As soon as the flax is dry, which depends on the weather, it must be rippled; that is, the capsules that enclose the seed should be pulled off. For this purpose a cloth is spread on the ground, in the middle of which is set a ripple, which is a bench with a kind of rake fixed on half its length, the teeth of which are slender and pretty close: two workmen sit on the ends of the bench straddling, and taking small handfuls of the

flax, draw it through the teeth of the ripple, and by that means separate the capsules, that contain the seeds, from the plants, which last they give to women who attend to tie them in bundles. This work is quickly done when the flax has been previously sorted; but if that were omitted, a part of it would be rotted before the rest were rated enough.

When the capsules are thus separated by rippling, the stalks are tied in bundles, the band being at the smaller end, to admit the water to penetrate the whole length of the stalks, which would not be the case if they were tied in the middle. Before I treat of rating the flax, it will be proper to mention the manner of separating the seeds, and cleaning them.

The capsules are exposed to the sun for some days, then lightly thrashed, and sifted. By this means the finest seed, and fittest for sowing, is got. It is cleaned by winnowing; the siftings are afterwards beat with a stick, or slightly thrashed with a flail, to open the capsules that were not quite ripe: and this second seed is cleaned first by fanning, which takes away all the light matter; it is then put into a sieve with oval holes to let the linseed pass,

pass, and all the large seeds remain in the sieve; lastly, it is put into a very fine sieve, which lets thro' the thin seeds and the dust.

When the best seed is set apart for sowing, the rest serves to make linseed oil. When linseed is preserved in granaries, it should be frequently stirred: the next thing to be done, is to carry the flax stalks to the water, to be rated without delay, in order to take advantage of the heat of the water, which at this season is every day lessened: for if cold weather should set in early, the flax stalks must be kept in barns, as it could not be rated till the following year, which is a great disadvantage; for by that means, the working the flax must be put off till summer, when there are many other things to do.

All waters are not equally good for rating flax. As by this operation the flax should in some measure ferment, a cold running stream is not proper to produce this effect: consequently, it is not proper to put flax to rate in rivers of running water; for when the river swells, the water either carries off the flax, or loads it with mud. A pond in a marsh is subject to many inconveniencies: the water stains the flax so

much, that the yarn is afterwards with difficulty bleached. Ponds of standing water are best; for, though the flax is tinged in them, yet, as this staining proceeds from the flax itself, it is soon lost in the bleaching. The best rating-ponds have a small rill of water running into them, which is discharged over the brink. These ponds should be dug in close soil, and open exposure, that they may not be muddy, that the sun may warm the water, and that no leaves may drop into them to stain it.

After the bundles of flax are tied in couples, they are regularly laid in the water, and covered either with straw or heath; and a hurdle loaded with stones is laid to keep them under water, without, however, pressing too hard on them.

The flax takes up a longer or a shorter time to rate, according to the nature of the water, the heat of the weather, and the quality of the flax, which is more or less woody: flax is sooner rated with a south, than a north wind; and what is pulled green is also much sooner rated than that which is very ripe. Thus it is impossible to fix a period, to know when it is sufficiently rated. A bundle should
be

be taken from the middle of the heap: if the stalk snaps short without bending, and the bark comes off easily, it is rated enough, and must be immediately taken out of the water, or it will be too much penetrated, and rot.

In some countries, they leave the flax only four days in water, when they take it out, and laying the bundles regularly side by side, they form a thick bed, upon which they put planks loaded with stones. In this manner they leave the flax for four or five days, or more, according to the heat of the air; and the rating is completed.

When the flax is taken either from the rating-pond, or from the heap above mentioned, the bundles are spread open at the roots, and laid on a dry new-mown meadow, in order to dry, bleach, and supple it. It is turned from time to time; and when it is very dry, it is carried off, or it would continue to rate almost as much as in the pond: for in some places, instead of putting the flax into water, they lay it on a damp meadow where the grass is long; they leave it there all the night and morning; and before the sun
has

has dried it, they gather it in a large heap, spreading it again at night: this they repeat till the flax is sufficiently rated, when they let it dry, and carry it into the barn. This is a tedious and troublesome operation: but they say it makes the flax whiter; yet this is but a trifling advantage, and I cannot think it of any use, except when the flax, having been put into the water, is not enough rated.

As I have mentioned, that in pulling the flax, care should be taken to separate the large stalks from the small, and the ripe from the green, it follows of course that some should be rated more than others, and that the different sorts should not be mixed when carried into the barn, that the flax-dressers may distinguish them,

SECT. IV. *Of drying Flax.*

As the thready parts are to be separated from the stalks, that it may the easier be done, the flax should be dried, till the stalks become very brittle.

As there is danger from fire in this operation, it is generally done at a distance from any buildings. I have seen excellent dry-

drying-places made under a large rock. Sometimes they are dug in the slope of a hill, and when the earth has tenacity enough, the upper part of the drying-place, or stove, is formed of it, or else an arch is made of the stone that is dug out: they vary according to different circumstances.

There are two methods of drying flax: some, having first fixed uprights and cross pieces against a wall, lay a hurdle on them, the bars of which are small, and about two inches distance one from the other: on this hurdle is laid the flax, four, five, or six inches thick: a small fire is carefully made under it, and the flax is frequently turned, that it may dry equally: the drier first takes off that next the wall, and pushing the other forward, lays some fresh flax on the outward edge of the hurdle. This operation should only be trusted to a very careful workman, for if the flame rises too high, it will catch the flax: this however seldom happens, and when it does, it is no great loss, as but little is laid on the hurdle at a time. Some say that the smoke hurts the colour of the flax, which lessens its price, but that the linen made of it is

is not of inferior quality, as the bleaching remedies all defects.

The other method of drying flax is by putting it into a hot oven. The largest ovens are fourteen or fifteen feet deep, eight or ten feet wide, and five feet high within side; and the mouth is large enough for a girl to go in. When the oven is heated, it must be well cleaned before the flax is put in; for the least spark will set it on fire, and this would be a considerable loss, as these ovens hold a great deal.

When this is clean, a middle-sized girl goes into it, and lays the flax regularly: they then shut the oven, leaving the flax in it all night.

My saying that a girl goes into a hot oven, may appear odd; but it must be observed, that these ovens are seldom heated to more than fifty or fifty-five degrees of M. de Réaumur's thermometer: I have seen a girl remain a quarter of an hour in an oven heated to bake bread, without being hurt by it, though the heat was as great as one hundred and thirty-five degrees of the same thermometer.

The next morning they take out half the flax, which they lay in a heap, wrapped
up

up in a cloth, where the brakers take it by handfuls: at noon they take out the rest, and immediately heat the oven again, in order to fill it at night with fresh flax.

It is necessary to observe this order; for they must brake the flax whilst it is hot, or the threads would be strained, and a great loss would ensue.

SECT. V. *Other necessary Operations in preparing Flax.*

The stalks of the flax being thus dry, they proceed immediately to brake it whilst it is hot, as we have already noticed, which consists in bruising it in a machine which we shall describe.

The brake is a kind of form made of a piece of wood five or six inches square, and four or five feet long. This piece of wood has two large mortises, at least an inch wide, which go through it, and reach from one end to the other: these two mortises leave three divisions, which are sharpened. On this piece of wood is fitted another, fastened to the end of the first by means of an iron pin, which gives it the motion of a hinge; the other has a handle: the upper piece has

has two sharpened eminencies which go into the mortises above mentioned.

The workman takes a handful of flax in his left hand, and taking hold of the handle of the brake raises it; then putting the flax in near the hinge, to have greater power, he presses it strongly down, but with a uniform motion; and this he repeats several times: when one end is done, he turns the other, twisting the part he has been braking, round his hand: when he has thus done about a pound of flax, he doubles it, and loosely twisting the ends together, it is called rough flax.

I have seen small brakes for flax that were all iron, and not above two feet and a half long: as it was not the time of year for braking, they told me it only served to give the flax a second dressing after it had passed through the brake above mentioned.

These small brakes certainly detach a great part of the smaller hards; yet much is still left for the swingle to perform. The instruments necessary to swingle flax are, a tressel, and a swingle. The tressel is a piece of wood from fifteen to eighteen inches wide, eight or nine inches thick, and from three to four feet long: at one end of it rises a board an inch thick, from ten to twelve

twelve inches wide, and three feet and a half high. On the upper end of this board, which rises perpendicularly and vertically to the piece of wood that forms the foot of the tressel, is a large semicircular notch, five inches wide, and three inches and a half deep: the angles of the notch should be lowered and made very smooth, that they may not tear the flax.

The swingle is made of a thin board, which should be seven or eight inches broad; for, if it was narrower, the flax, on being struck, would twist round it: the wood of the swingle must also be well polished, and without notches, or it will tear the threads of flax.

The workman takes in his left hand a handful of flax nearly in the middle; and laying it on the circular notch of the tressel-board, in such a manner that half of it hangs down the board, he strikes this part of the flax with the swingle, giving moderate strokes, that he may not break the threads: he then shakes the flax, to disentangle the hards, and laying it again on the notch, continues this operation till the flax appears clean, and the threads lie straight; then turning the flax, he does the same to the
other

other end. The workman must be attentive to swingle the middle of the handfuls, as well as the ends, and be careful not to strike the edge of the swingle on the notch of the board, which would cut the threads: he must also be careful to hold the flax tight in his left hand; for the threads that fall among the hards encrease the waste.

The swingle clears the flax of a great deal of the hards; but the dresser should handle the swingle lightly, that as few of the filaments may be broke as possible.

When the middle of the handfuls of flax comes coarse from the hands of the swingler, it is cleared by means of a piece of iron, three or four inches wide, two lines thick, and two feet and a half long, vertically and firmly fixed by two strong staples to a post: the edge of this iron should be blunt and polished. The dresser takes a handful of flax, by the larger end, in his right hand, putting it behind the iron; and taking hold of the other end with his left hand, he presses the middle against the blunt edge of the iron, drawing it backward and forward.

Many dresseers beat their flax with a large mallet on a block, to separate the fibres, and make

make it soft and pliable: some, before this operation, put the ends of the flax in an instrument contrived to prevent the threads from scattering in beating; but in this way, if great care is not taken, there is a considerable waste.

There are other dressers who, having chiefly in view the procuring very fine flax, make use of an instrument called a *refiner*. This consists of a board one inch and a half thick, fixed to the table on which are the combs: this board has a hole in the middle, three or four inches diameter, the upper surface of which is cut in notches. In using the instrument, the flax is put through the hole, and drawn backward and forward on the notches: this refines it much, but it breaks many of the fibres, tangles others, and occasions a great waste. I have prepared some very fine flax this way, and ordered the dressers not to mind the waste, which was indeed considerable: my flax was indeed by this means fine, and as soft as silk; but the yarn made of it was covered with down, and the cloth seemed thread-bare.

In the memoirs of the Dublin society there is a description of a Dutch mill to dress

flax : this machine seems preferable to any of the methods I have mentioned ; but as I have never tried it, I cannot assert any thing relative to its operations till I have got such a one erected. This mill is said to separate the fibres to admiration, without any great waste, or straining the flax.

When the longitudinal fibres of the flax are sufficiently separated, the dressers give it the last preparation, by passing it through combs with iron or brass teeth, called hackles: this is therefore termed hackling the flax.

The hackle consists of seven or eight rows of iron or brass teeth, somewhat like the teeth of a rake, strongly fixed into a board of hard wood, which may be strengthened by an iron plate : the teeth of the large hackles should be filed in form of a lozenge, the small ones round, and they should all be placed chequerwise.

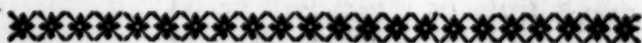
To dress flax properly there should be hackles of four sizes: the teeth of the great one are at bottom one line square, and are three inches and a half long; and the teeth of the smallest are of the length and thickness of such needles as are used for sewing home-spun cloth.

The flax is first combed with the largest hackle; but great care must be taken in doing

doing this, or much will be wasted. It is then passed successively through the other hackles; and as this work requires more care and skill than strength, it is generally done by women, who afterwards tie it in parcels just enough to put on the distaff at once. This is the finest flax.

What remains in the hackles is combed afterwards, and a fine flax is got from it, but shorter than the first, with which it is sometimes mixed: the remainder is the tow.

What I have hitherto said relates to the culture of flax by hand, either with the hoe or spade. This is past dispute the best way; but it is also the most expensive: it may however be cultivated with the plow, provided it is made to cut deep; for flax pushes its roots to a great depth. I have observed in my Treatise of Husbandry, that Mess. de Chateauvieux, Aimen, and several others, had good success in sowing flax and hemp in rows in the new way; yet, as the plants yield only a coarse thread unless they are sown thick, it follows that this method can only be of service when good seed is wanted.



CHAP. III.

Of Hemp, (Cannabis.)

AS I have enlarged on the culture, and methods of dressing of flax, I shall say but little on the subject of hemp, as these plants greatly resemble one another in many respects: it will be sufficient to observe, that the same land is proper both for flax and hemp, and each requires the same culture, and the same manure. Hemp, like flax, is sown in April, with the last year's seed; and when it comes up, it must be guarded from birds; for, as it brings up the husks of the seed with it, the birds are very apt to pluck up the plants. Flax plants are all hermaphrodites, and bear seed: but in hemp some plants are males, and yield the impregnated *farina*, or male dust; these are the *cannabis florifera*: others are female, and bear seeds, *cannabis fructifera*.

The male hemp ripens before the other: it is pulled the beginning of August: when it grows yellow at the head, and white at the foot, is the time to pull it. The female
hemp

hemp is left to ripen the seeds. At this time some turnip seed is strewed on the land, which is covered by pulling up the plants of hemp: by this means a crop of turnips may be had when the hemp is off the land.

This male hemp is dried and rated; for, as it is more valued than the female hemp, it is best not to mix them. The method of rating it is the same as for flax, except that hemp must lie somewhat longer in the water.

When the seed is formed and perfect, the female plants are pulled in the same manner the male were some weeks before: they are tied in small bundles, which are laid head to head in a large heap: the heads are covered with grass, over which is laid some earth; or else a ditch is made, in which the heads of the bundles are put close together, and the earth thrown in again close to the stems. The heads disposed in this manner heat, and the seed ripens, so as the easier to quit its husks.

In about a week the bundles are taken out of the ditch, and spread to dry: the heads are then laid all one way; and they are lightly thrashed, either with a stick, or a

small flail. The seed that now drops is the best, and is kept for sowing. The heads are then rippled in the manner directed for flax: by this means the dry leaves, the capsules, and the seed, fall mixt together. The whole is made into a heap, which some days afterwards is spread, and exposed to the sun: it is then lightly thrashed, and the seed is cleaned with a fan and screen. In the mean time the stalks are rating: when they come out of the rating-pond, the bundles are untied, and they are spread out to dry, like flax, and are afterwards put under cover.

Such as have but little hemp pill it; that is, breaking the stalks, they separate the hemp with the finger: but such as have much hemp brake it, in the same manner flax is done, only the brake for hemp must be stronger and larger.

I shall just observe, that some say, if the hemp was all to be pulled at the same time, without regarding the seed, it would all be of the same fineness; whereas, in the common way, that which is last pulled is much the coarsest. I have not experienced this.

The dressing of hemp is in every respect the same as for flax, except that the instruments

ments must be stronger : however, let what care will be taken, it is very difficult to get as fine yarn from hemp as from flax ; but hemp is, for some purposes, stronger and more lasting.

It is necessary to observe, as well with respect to hemp as flax, that if the summer is rainy, cold, and backward, so that it cannot be rated before the chill autumn comes on, it may, after being rippled and well dried, be kept under cover till the succeeding spring, guarding it as much as possible from the rats and mice.

Hempseed is kept in granaries in the same manner as linseed : it serves for sowing, making oil, and feeding poultry.



C H A P. IV.

Of the Teafil, (Dipsacus fativus, C. B.)

THE kind of teafil we are about to treat of has a stem four or five feet high, about an inch diameter, erect, stiff, branching, furrowed, and furnished with some few prickles. The leaves of it are long, armed with prickles, and set in couples

along the stem and branches: they encircle the stem, thereby forming a kind of little basin, in which the rain water and dews are collected: the stems are terminated by large prickly heads in form of an egg: the spines are hard and channelled; they are placed like scales, and betwixt them are cavities, in each of which is a floret composed of a pipey petal, which when it comes out of the cavity spreads, and is notched at the edges: the embryo becomes a furrowed seed, having four ridges.

The teasil grows in any soil, but is not equally good in all. In moist lands it grows very large, which occasioned M. Linnæus to say, that such a soil agreed best with it: but the heads are not so good when they grow either in a moist soil, or in the shade.

1. The teasil requires a free air: it does not grow equally perfect in all places. Chalky, flinty hills, in a good exposure, produce the best. Such are the lands of Sotteville-sous-Val near the Pont de l'Arche, which bear the best teasil in Europe. The same quantity that is sold in other places for thirty-five livres, costs there fifty; but, as the quantity of this teasil is not equal to its quality, it is rather more profitable to cultivate

vate teafil in strong low lands, than on hills; fresh land is particularly favourable to it.

2. The several methods of preparing the land differ as much as the soils themselves do, according to the time and manner in which it is to be sown. Such as sow in spring must prepare their land before winter; that is, give it a plowing, and lay on dung: it is plowed again in spring, and immediately sown. Such as sow in July or August, on land that has just yielded a crop, are content to dung the land before they sow it, giving it a single plowing. Finally, when it is sown either with wheat or rye, the land is prepared in the same manner as for those grains. The tillage is all done with the plow, except in steep places, where they are obliged to use the spade and mattock: the land is tilled deeper or shallower according to the nature of the soil. The peasants in this case are governed by custom, for which they cannot always give a reason. We may venture to assert, that it is dangerous to go too deep on hills, or shallow soils, as several years would be necessary to recover them; but in good soils a deep plowing would, it is presumed, give freer ingress to the roots, which run very deep.

3. Teafil

3. Teafil may then be sowed at two different seasons, and by itself, or with other seed. When it is sown either with wheat or rye, in September, the corn must first be sown; then the teafil must be scattered by very small handfuls, and the land harrowed. The corn and rye are, it is well known, ripe the August following. As for the teafil, it is not fit to cut till the July after; so that, when it is sown this way, it occupies the land almost two years. When teafil is sown either by itself, or with weld or dyers-weed, it is spread very thin and lightly on the land: but this I do not think very essential; for as the seed is not scarce, it is much easier to thin it, if it comes up too thick, than plant more, if it is too thin. In this way it is generally sown in July or August, though it may be as well done in the spring. When a small plot is sowed, the seed may be raked in.

4. If we pay any regard to the etymology of *Dipsacus*, we must conclude the teafil to be a very thirsty plant; yet neither the seed nor plant are ever watered: and indeed I know but one circumstance in which watering could be of use; that is, when teafil is transplanted, and a great drowth ensues, a
little

little watering may make the plants take root better: but in large concerns this is not attended to; the countrymen are content to chuse a favourable season for their work, and leave the rest to providence.

5. When the teasil has acquired some size, it is carefully weeded, the plants are pulled up where they grow too thick, and others planted in the empty spaces. The proper distance for the plants to be asunder is six inches. Besides carefully weeding teasil, the earth about the plants should be frequently stirred, so as to be always kept loose and clean. There is not perhaps any which hurts it so much as that which the peasant calls *le Gras*: it is a parasite plant, that subsists on its root, and starves it by exhausting its nourishment: at first coming up it has the appearance of asparagus: it is a kind of broom-rape, (*Orobanche*) and is carefully extirpated as soon as it appears: it is more frequently found in rich, well-manured lands, than in others. It is unnecessary to observe, that the teasil which is sown with wheat or rye cannot receive the proper tillage while they are on the land. As to that which is sown with weld or dyers-weed, they may without inconvenience

nience receive equal tillage. If a hard winter is expected, as the teasil is tender, it must be covered with long straw.

6. Teasil must be cut according to the time of sowing it, and the strength of the plants. Teasil sown with wheat or rye, in September or October, runs up to a head in the second spring, and being cut in the fine weather, is much the best and most certain crop. If the stalks do not all rise in spring, the rest are left till autumn: when the stalks begin to rise in this last season, and that is the case when it is sown in July or August, only a part rises; the rest remain till spring. If the latter plants are but few, the land is turned up for another crop; but when enough remains to cover the land, they are carefully preserved for the winter, being covered with long dung; and the expence is amply defrayed in spring, by a crop excellent both in quantity and quality.

7. The teasil is known to be ripe when the blossoms are all fallen off the heads, and they begin to look white and dry; but they do not ripen all together. The heads must be carefully gathered every day as they ripen, and this takes up near three months.

In

In cutting teasil they do not pull up the whole plant; the ripe heads alone are cut, with about a foot of the stalk to tie them in bunches. When the teasil-heads are dry, the seeds are ripe.

8. To preserve the teasil-heads, nothing more is necessary than to house them when they are dry. Were they left in the rain, they would take damage: teasil requires no rain after it begins to bloom; for, if it proves rainy when it blossoms, or ripens, the crop suffers, and is sometimes entirely lost; the wet injuring the spines. Teasil, to be very fine, should have the head elongated and cylindrical, with stiff slender spines. Such as grow in the low land are generally shorter, more conical, with thicker spines, than what are produced by the hills.

9. To procure teasil seed, it is only necessary gently to shake the heads when they are dry. The good seed easily falls from its cellules: it is even found in the barns, under the parcels of teasil, in sufficient quantity for sowing. This seed keeps long: it is however seldom sown above two years old.

Sheeps dung is most proper for teasil; yet those that cultivate it are indifferent in their choice

choice of dung, using that which is easiest procured. But we may reasonably conclude, according to the general principles of Agriculture, that warm manures are more particularly adapted to moist cold lands, and cold manures to such as are high, and have a warm soil. To this we may add, that all hot dungs are to be preferred for lands that are plowed before the winter, as they will be buried before spring seed-time; and the cold dungs should be reserved for such land as is sown in July and August.

We may conclude from what has been said, that by preparing the land in autumn to sow the following spring, the stalks of the teal will rise in June; and such as do not rise then, may the following September.

I have cultivated teal from seed sent me by M. d'Angerville from the academy at Rouen, following the directions he gave me, and which are mentioned above: it was attended with success.

As teal is soon damaged by hard frosts, and as covering the field with long dung is very expensive, to save trouble it may be sowed in July, and afterwards transplanted, for it takes root very well. In this case the seed must be sown pretty thick in a well-sheltered

sheltered place, which must be covered in frosty weather with long dung; and early in the spring it must be planted out at eight or nine inches distance in the rows: by stirring the intervals with a plow, the trouble of hand-hoeing will be reduced almost to nothing.

The manufacturers who use teasil for their woollen goods, chuse it for the stiffness of the spines, which should be greater or less according to the nature of the work.

BOOK XI.

*The Culture of some Plants fit for
Dyers Use.*



CHAPTER I.

Of Weld or Dyers-Weed, (Luteola.)

THE weld that is raised for dyers, and is called *Luteola salicis folio*, C.B. puts forth long narrow leaves, soft to the touch, from which arise stalks three or four feet high, hard, greenish, branching, and furnished with leaves smaller than those at the bottom. The tops of the stems, and the ends of the branches, are furnished with long spikes of small yellow flowers formed of petals of various sizes: the pointal becomes a capsule nearly globular, terminating in three points: these capsules contain the seeds, which are spherical, and of a brown colour. The plant becomes entirely yellow when dry.

Weld

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Weld is cultivated in Spain and France : it grows wild on highway-sides and walls ; which shews that it is no tender plant, and is not difficult to raise ; however, it becomes more vigorous, and fit for the dyers use, in proportion to the care that is bestowed on its culture.

Weld is sown in March ; but, as its seed is almost as small as that of purslane, great care must be taken not to sow it too thick, which may easily be prevented by mixing it with ashes, buck-wheat, or oats.

The only care this plant requires whilst it is on the land, is cutting up the weeds that would either choke it, or weaken its growth. About July or August, when the greatest part of the seed is ripe, the weld, which is then of a greenish yellow, is pulled ; it is dried, and thrashed on cloths to get the ripest of the seed ; after which the stalks are tied in bundles, and sold to the dyers. The plants should, I say, be pulled when part of the seed is ripe ; for they are not so good if left too long standing ; besides, some of the best seed is lost.

The last year's seed must be sown : if it is two years old, only a part comes up : if the plants were cut, instead of being pulled,

most of them would sprout again. I do not however think any benefit results from this practice; I always thought it best to pull the weld when it was of a proper ripeness. Weld is known to yield a fine yellow dye.



C H A P. II.

Of Wood, (Isatis fativa vel latifolia, C. B.)

THIS plant puts forth stalks three feet high, about as big as the finger: they are divided at the top into many branches, with plenty of leaves growing without order. These leaves, which resemble those of dog's-tongue, are sleek, and of a bluish green colour. The branches bear also flowers composed of four yellow petals, in form of a cross: the pointal becomes a capsule flattened on the edges; each capsule contains two oblong seeds; the root is large, woody, and pushes deep into the land. This plant thrives well in our southern provinces, in Provence, Languedoc, &c. it thrives also in Italy;
it

it is however cultivated in Normandy, and is said even to succeed in Germany.

A light, black, kindly, rich soil is generally chosen for woad, it delights particularly in a good meadow newly broke up; but it must not be sown on a stoney, or shallow soil. Woad succeeds well in the flat country, but better on the side of a hill exposed to the south: the principal thing required is, for the soil to be good, and of the nature already described. Let the land destined for woad be ever so good, it must be well dunged a year before sowing, and a crop of wheat, or onions, &c. be taken off it. When these are gathered, the land should have three deep plowings, or, what is much better, be as many times well dug with the spade: the first time should be in November; the other two, in February, March, or April. If the land intended for woad is flat, and has not slope enough to carry off the wet, there must be water-furrows cut, proportioned in size to the nature of the land.

Woad is sown from the beginning of April; but, if the weather is very cold, it is deferred till the beginning of May. When the land is laid smooth, and the

clods are broke, it should be sowed thin enough for the plants to be six inches asunder. The seed must be lightly raked, or harrowed in: some spread pigeons dung on the land after it is sown, which does great service.

When the woad is grown large enough to be distinguished, the weeds, which would injure it greatly, must be carefully pulled up; and, if the plants stand too close, they must at the same time be thinned, or the woad would be very small, and bear but few leaves.

The plants must be hoed as often as the season requires, being at the same time earthed-up. I have been assured, that in countries where they have water at hand, they water woad by sprinkling; but this should be frequently repeated, or the heat of the sun will harden the surface of the land, and injure the plants.

They generally get two crops of woad in a year, and, in favourable seasons, even four: the first is got towards the end of August; and the last, the end of October, or beginning of November: but this last crop must be got in before there are any hard frosts, or the leaves will be worth nothing.

thing. When the plant is in proper order, which may be known by the under leaves beginning to dry, all the leaves are cut, being laid in heaps to wither: during this time, they must be kept from the sun and rain, and must be frequently turned, that they may heat equally: they are then carried to a mill, something like that which is used to express the oil from linseed: here the leaves are bruised till they are reduced to a paste, to be formed into cakes of about a pound weight, which must be dried in a place sheltered from the rain and sun: these cakes are left to dry for about a fortnight; that is, till they have consistence enough to be reduced to the state in which it is sold.

Woad yields an excellent, and very lasting blue dye, in all its shades. It is not long that indigo has been preferred to it; it was first, as it were, by toleration mixed with the woad, but is now indifferently used.

At the last cutting of the woad, they take off the crown of the root. When seed is wanting, at this last cutting some of the plants should be left with a part of their leaves only cut: for, were they

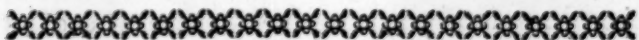
all left, the stalks would rise too soon, and the cold of the succeeding spring destroy the seed; for seed sown in April should not bear seed till August in the succeeding year; therefore, if some of the leaves are not cut in October, the plants will be too forward.

Besides cold, weeds, and drowth, which greatly injure woad, the locusts sometimes devour a whole field in an evening: when this happens, all the leaves must be immediately cut, that the plants may sprout again.

The same field should be left in woad the second year. First wheat, and then millet, may be sown; and the third year, if the land has been well manured, woad may be sown again.

I sent an account of the culture of woad to the late M. Fontenette, correspondent of the royal academy of sciences, and a physician in Louisiana, with a view of inducing him to cultivate the plant in that colony, and endeavour to extract from it a sediment like that of indigo: M. Fontenette, on the contrary, tried what effect indigo would have if managed like woad;

woad; he procured a very fine green, but did not inform me whether it was lasting.



CHAP. III.

Of Saffron.

SAFFRON is of great use in medicine. As many nations season their ordinary food with it, and as the consumption of it in dying is great, a perfect knowledge of the plant and its culture is necessary, especially as botanists, and such as have written treatises on the *Materia medica*, give but very superficial descriptions of it, and do not mention its culture. It is astonishing that the culture of it should at this day be so little known, though it has long been raised in the province of Gatinois, which is at no great distance from Paris. I think it incumbent on me to present it to the public, as it seems to be the desire of many that I should.

Pliny mentions the saffron of Africa, Sicily, and Asia; but he takes no notice of this plant's being cultivated in Gaul.

La Rochefoucault, who in the last century wrote a treatise on the culture of saffron in the Angoumois, says there was but little saffron there before one thousand five hundred and twenty; but that, since that time, the saffron raised there has been much esteemed, and that the crops of some years have been equal in value to the purchase of the land they grew on.

I have not been able to discover when this plant was first cultivated in the Gatinois; but it is within the memory of man: the saffron raised there is preferred to that of the principality of Orange, of Languedoc, Poitou, England, Germany, Italy, &c. This superiority is owing to the nature of the soil, the climate, and perhaps the method of culture; for the plant is the same in all places.

SECT. I. *Description of Saffron.*

Matthioli called this plant *Crocum*; J. Bauhin, and Dodoneus, called it *Crocus*; Gaspar Bauhin in his Pinax, and Tournefort, term it *Crocus sativus*; finally, Park, and Ray in his History of Plants, have given it the name of *Crocus sativus autumnalis*.

nalis. This plant, as well as the dried pointals of it, is known by the name of saffron.

It is a bulbous plant; its bulb is firm and fleshy; the best of them are about an inch diameter, and one inch and a half high; it is flattened above and below, and somewhat sunk.

The substance of this bulb is defended by several dry coverings of a russet colour, composed of a number of fibres placed parallel one to the other: these coverings are called the coats of the bulb.

In a cavity which is in the middle of the upper part of the bulb, one may perceive one, two, or three excrescences of a bright russet colour; and others smaller are seen on the sides of the bulb: it is from these places, which are a kind of buds, that the leaves, flowers, and even suckers proceed, as we shall hereafter notice. By raising the conical coverings of these buds, a kind of nipple may be perceived of the same form, which, being cut lengthways, appears to be a small bulb enclosed in the larger, and containing the rudiments of the plant.

The

The body of the bulb, cut different ways, appears to be a uniform substance, not unlike the flesh of an apple.

In September, when the autumnal rains begin to moisten the earth, the roots shoot from the bottom of the bulb; the nipples above mentioned lengthen, and the flowers begin to disengage themselves from the coat of the bulb.

The flower-bud, covered by a thin hood composed of several membranes, and fixed to its footstalk, rises to attain the surface of the earth: as the footstalk lengthens, the bud disengages itself from its hood, and appears in an oval form, one inch and a half, or two inches long, and five or six lines diameter: it is supported, as it were, on a footstalk, by a pipe, or tube, above a line diameter; this tube is the lower part of the flower, and the flower rises about two inches out of the ground.

The fistulous part of the flower widens considerably above where it is divided in six large parts, which being joined form the bud above mentioned: they afterwards separate and spread; and when the flower is full blown, each section appears like a large petal, so that the flower then resembles

bles a small tulip with a picked base. As this flower is of a light purple colour, the fields planted with them have a very pretty aspect.

Three of these sections, or parts, are somewhat larger than the other three; they are about two inches long, and one inch wide: within the flower are to be seen the chives, which proceed from the sections of the flower: these chives are composed of a whitish filament, which supports a summit five or six lines long, consisting of two capsules, which opening lengthways scatter a dust of a very bright yellow colour.

The pointal consists of an embrio, which supports the flower: it is oval, and about half an inch long: it is supported by a filament which proceeds from the bulb itself, and which runs the whole length of the footstalk, which is fistulous. This embrio, which is of a triangular shape, becomes, when the flower is passed, a capsule with three cells, which contain several round seeds: the style, which is single, runs along the narrow part of the flower, and when it has proceeded about four or five lines in the open part, it divides itself into three large

large blades from fifteen to eighteen lines long. The style is white; the blades of a lively bright red; they are long enough to reach beyond the divisions of the petal; they are smaller at their origin than their ends, and have minute furrows in them. These blades alone yield the true saffron.

If you pull up a bulb in the blowing season, the leaves may be seen in number from two to eight, sheathed like the flower: some time after the flower is passed, the leaves appear above ground; they are narrow, and from one to two feet long; they are channeled, being grooved above, and ridged beneath: that part of the leaves which is in the earth, is yellowish; the other, of a brilliant green, insomuch that saffron-grounds appear to be covered the whole winter with a beautiful verdure: the leaves grow yellow in spring, and by degrees wither: they are then cut off; and during the whole summer, the saffron-grounds that are properly cultivated appear to bear no kind of plant whatever.

The small buds on the bulbs, which have already put forth flowers and leaves, grow by degrees larger during the winter:

the bulb itself decays, withers, and dies, in the same proportion as the little buds increase in size; so that in the spring three or four new bulbs supply the place of the former, which is almost reduced to nothing. It is on account of this increase, that it becomes necessary to take up the bulbs every three years, as will hereafter be observed.

By what has been said, it is evident that the character of saffron is, instead of the empalement, to have a hood composed of one part: the petal is single; at the bottom it is a small tube, which as it ascends is divided into six large oval sections; within are three large stamina, which rise from the petal, and are much shorter than the sections of the petal: these stamina consist of slender filaments and summits, composed of two long capsules, which contain the male dust.

The pointal consists of an oblong embryo, a filamentous stile, which rises as high as the stamina, and three stigmas, larger at the top than at bottom, and striated lengthways.

The embryo becomes a capsule with three cells enclosing several roundish seeds.

There

There are several sorts of saffron, which blossom in spring, and are cultivated for the sake of their flowers, which are very pretty: the sort we now treat of, and which is applied to particular uses, blossoms in autumn.

SECT. II. *Of the Culture of Saffron.*

Light lands are most proper for saffron. It does not thrive in poor sands, nor in stiff, clayey, damp soils: stoney lands are not to be rejected, provided all the stones that are bigger than hazle-nuts are picked off: this is troublesome work, it is true; yet is it often done.

It may in general be said that there are two sorts of soil proper for saffron; that is, black light lands, somewhat sandy, and the brown russet soil; both of which must be eight or nine inches deep.

It has been remarked, that saffron thrives well in black mould that has some tenacity: the bulbs grow large, and produce a great number of fine off-sets. But the russet-lands are most proper to make them blossom finely. This in some measure agrees with an observation of florists, who say,
that

that a soil which has some substance and tenacity, invigorates the roots, but that the flowers come finer in light poor earth.

In the same land two sorts of bulbs are found; those that are broad and flatted produce most off-sets, but such as are round bear the greatest number of flowers.

There are also bulbs, which have two outward coats, of a fallow or deep red colour; and others are whitish: but these trifling variations have no effect on the crop, either of flowers, or bulbs.

Land intended for saffron is prepared by three good diggings, or plowings, in the space of a year; and the earth must be stirred nine or ten inches deep; so that, when it is in proper order, it is almost as loose as ashes; and great care must be taken to pick off the stones, and break the clods. The first stirring, which is called winter-fallowing, is given about Christmas; the next, called twi-fallowing, about April; and the third, which they name tri-fallowing, a little before the roots are planted.

La Rochefoucault says, in his work, that in the Angoumois they manure saffron-grounds twice with very rotten dung reduced to mould; and that hogs dung is

rejected; that of sheep, horses, and oxen, being good, provided it is well rotted. In the Gatinois they never manure saffron-grounds: it is perhaps on this account, the saffron of that province is in such superior esteem.

Though Pliny says, that saffron should be trodden in the ground, yet are they here very careful not to walk on the saffron-grounds, nor to suffer cattle to tread on them, particularly when the land is wet: the feet of horses and oxen would damage the bulbs; besides, the treading of men hardens the ground, and is an obstacle to the rising of the flowers.

The bulbs suffer considerably when the leaves are cut off: for this reason, the herds-men take great care to keep the cattle out: some enclose their lands with hedges and ditches to keep them out; but these are no defence against hares and rabbits, which are very fond of saffron leaves; therefore, when a saffron-ground is exposed to them, it should be paled in so close, that neither a hare nor rabbit can get in.

Moles should also be destroyed; for, though they do not eat the bulbs, yet they make subterraneous passages, which give entry

entry to the field mice and rats, which feed on the bulbs: for this reason saffron-grounds do not in general succeed well that are too near houses.

When the land is brought into proper order, the bulbs are put into the ground in June, July, and August, in the following manner.

A labourer opens, at one end of the field, a trench, with a small spade, about seven inches deep: he is followed by a woman or lad, who places the bulbs in it at an inch distance from each other. When this row is finished, the man begins another trench, and fills the first with the earth, so that the bulbs first planted are covered with about six inches depth of soil: he also observes to make the second trench at such a distance from the first, as that the rows of bulbs may be at six or seven inches distance. The labourers are so much used to this work, that the rows will be as regular as if planted by a line, though the eye is the only guide.

Whilst we are making our plantation of saffron, we must observe, 1. That some replant the bulbs as soon as they are taken up, alledging that they blossom better for it; others, taking up their bulbs in July,

replant them again in September, asserting that by being dried they are less subject to rot. As no reason can be assigned why they should rot sooner, the first year they are planted, than the second and third, the first appears to be the best method.

2. Most people plant the bulbs with the outward coat on; others take it off, as it gives them an opportunity of examining the bulb, and rejecting such as are attacked either by the *deadly plague*, or the rot, (we shall in due time mention these diseases) or cutting off the infected part, if the disorder has not got to too great a head: though this method of peeling the bulbs takes up time, it is however to be preferred.

3. La Rochefoucault says, that the large bulbs may be cut into two or three parts, to encrease the number. It is admitted, that, if a large bulb is cut into several pieces, they may grow, provided a bud, which is the source of the leaves and flowers, is left on each part: yet this method is not to be recommended, as it is certainly better to have a few well-conditioned roots than many that are indifferent.

Soon after the saffron is planted, it sends forth roots; and when the autumnal rains begin

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begin to penetrate the earth, the blossom begins to rise: a slight stirring is then given it, the ground being loosened to about two inches deep; but care must be taken not to cut the flowers with the hoe.

The flowers appear the beginning of October, when they are gathered and picked, in the manner hereafter directed. When the plants have done blowing, the leaves shew themselves, and the saffron-grounds remain green during the whole winter: towards the end of May, when they are almost withered, they are cut and given to cows. In all this time the ground is not stirred.

About the middle of June the first stirring is given to the depth of three or four inches; another is given at the end of August; and towards the end of September the third stirring is given, which, like that of the preceding year, is but slight, to the depth of two inches: and about the beginning of October the flower appears.

The same method is pursued for three years, and the fourth the bulbs are taken up, which is generally done in June, July, and August.

In taking up the bulbs, they do it row by row, uncovering them with the spade, taking care however not to damage them : for this purpose the ground must be cut deeper than the bulbs were planted. Women and children follow the workman, carefully gathering up the roots, which they put in baskets, and carry to a corner of the field, where they are laid in a large heap. La Rochefoucault says, that being put into baskets, they are carried to the granary, and stirred like nuts. With us they use no such precaution : some, as we have already said, leave them in the field a month or six weeks, and others replant them soon after they are taken up : some take off their outward coats ; others plant them without doing so : all in general plant them in different fields ; for the earth is so exhausted, that it requires fifteen or twenty years interval before saffron-bulbs can be again planted in it. Oats and saintfoin are generally sown after saffron : it is thus left for nine years, when vines may be planted, or first barley, and then wheat, be sown. Perhaps, if these lands were dunged, they might sooner be in a condition to be again planted with saffron ; but this is not the custom in the Gatinois.

The

The same writer has observed, which we have also done, that the same lands will not long do for saffron; so that none of it is now raised in some parishes, in which was formerly a great deal. These districts now bear corn; but after a length of time they will again bear saffron.

As the ground is not full stocked with roots the first year, the crop of flowers is not so large: it is much more profitable the second year; and there are still more flowers to gather the third; but they are not in general so fine as those of the second, because the ground begins to be overstocked; and for this reason the bulbs are taken up the fourth year. Half an acre generally furnishes bulbs enough to plant an entire acre.

La Rochefoucault proposes, that the roots should be taken up only every fifth year; but I should imagine, that, as the bulbs would then press against each other, they would of course be small. Six bushels of bulbs have produced thirteen in two years, and five bushels have yielded twenty in four years.

When the winters are mild, some advantage results from planting the bulbs only five inches deep, as the flowers rise with

more ease; but, as the saffron-bulbs are very apt to be injured by frost, and as they rise every year about an inch nearer the surface, to prevent the loss of them in a hard winter, it is better to plant them at seven or eight inches depth.

SECT. III. *Of gathering Saffron.*

The saffron flowers appear sooner or later, as the autumn happens to be dry or wet, hot or cold.

When, towards the end of September, mild rains happen to be succeeded by warm weather, the flowers come up very thick; the fields appear every morning to be covered with a purple carpet. It is then that neither night nor day rest is allowed; yet, notwithstanding all the care that is taken, a part of the flowers are lost, particularly if windy weather comes on, which bruises them, or rain, which rots them. These two dreadful evils were united in 1753: vast quantities of flowers were lost, though above two shillings were given for gathering a pound of green saffron; and what encreased the misfortune was, that it happened at the time of the vintage, which was that year late. In

some years however the saffron-flowers do not come up till the vintage is past, and they appear in successive order: at such times, as the saffron is longer gathering, there is an opportunity of gathering them all without loss. I remember one year in which hard frosts came on immediately after the first flowers that appeared were gathered, and no others came up to succeed them for a fortnight. All hopes of a farther crop were given up; but the weather growing mild, the flowers came up in successive order, and there was upon the whole a tolerable good crop. The saffron-gathering generally continues for three weeks or a month.

In the gathering season, men, and more commonly women, go at break of day into the fields with handled baskets: straddling, they tread betwixt the rows of saffron: they gather the flowers by breaking them under the cup; and when they have filled the right hand, they put them into the basket which they carry with the left. When the basket is full, the flowers are gently and carefully emptied into large baskets, in which they are carried into the house.

Saffron-flowers should be gathered as soon as they appear, and even before they are blown; if it was longer deferred, they would with difficulty be gathered: and, as the flowers soon fade, they begin to gather them before the morning-dew is off; and, in the height of the work, they even gather them in the night; but those gathered in the morning are in better order; for it seems, that saffron, which is an autumnal plant, grows more in the night than the day.

La Rochefoucault advises to cut the stalks with the nail, in gathering the flowers, because, he observes; if they are broke, instead of being thus cut, the pointal is left behind, and an empty flower is carried into the house: he adds also, that the wet penetrates through the broken part, and in time rots the bulb.

In the Gatinois they do not thus cut them with their nails: after having taken hold of them, near the ground, with the thumb and middle of the fore-finger, they bend the flower, and it breaks easily. In this method the pointal is never left behind, and the bulbs are not perceived to receive any injury. The people that are employed in

in gathering the flowers do it with such dexterity and quickness, that the eye can scarcely follow the hand of the gatherer.

When the flowers cannot be picked as fast as they are gathered, they are spread on the floor of a granary, and in this manner kept from day to day: without this precaution they would heat, and it would be scarcely possible to pick them.

As soon as the flowers are carried into the house, they are spread on large tables, round which the pickers sit, with a dish on their right side. They take each flower with the right hand, and bearing it to their left, take it by the part where the tube begins to spread: they cut the petal in this spot; after which, taking hold of one of the stigmas with the right hand, they lay them all together on the dish.

The expert pickers cut the pointal about two or three lines beneath the stigmas: if it was cut lower, it would take in a long white filament, which, having neither colour nor smell, would lessen the value of the saffron; if it was cut above the separation of the stigmas, these last would separate, and it would take up too much time to collect them: besides, the purchasers

chasers are not sorry to see the little white part; for some adulterate their saffron, and this discovers the fraud.

The purchasers are always disgusted when they find fragments of the petals in the saffron, because, as these parts are apt to mould, they give it a bad smell. As the stamina are without smell, they should be esteemed extraneous, or at least useless: when the pickers perceive any of them fixed to the pointal, they get rid of them by striking the finger of the right fist on the table: and all this is done with such expedition, that an expert picker will pick a pound of green saffron in a day.

Though the whole family is taken up, night and day, picking saffron, yet such as have any considerable quantity are obliged to hire gatherers for a whole month, which is about the time the season lasts. At these times may be seen waggon-loads of saffron carried to the towns and villages, where it is not cultivated, to be picked: for this they generally pay about three-pence, or four-pence a pound, but sometimes twenty-pence, or two shillings, according to the plenty of flowers, or as they are more or less difficult to pick.

As

As fast as the saffron is picked, it must be dried by the fire; and as this requires great care, it is generally the master or mistress of the house that does it, because too brisk a fire would do great damage. There are various ways of drying saffron: some use different kinds of pans; but in the Gasinois they spread it about three fingers thick on hair-sieves: they hang these sieves with cords, about one foot and a half from the ground: beneath they lay live coals, covered with hot ashes; and as the saffron dries, they move and turn it: if the fire was too brisk, the saffron would burn, and be almost entirely lost: smoke gives it a bad smell, and takes off the brightness of the colour. When the saffron is nearly dry enough to crumble betwixt the fingers, they put it into boxes lined with paper, and shut it down close. Five pounds of green saffron make but one pound of dry. When they are about to sell their saffron, they put the boxes full of it into the cellar to encrease its weight; but the factors, who buy it, moisten it much more, almost rotting it. The price of saffron has been for some time much lowered; for it was formerly sold for twenty (French) crowns a pound,

pound, and it is now worth only from twenty to twenty-four livres.

The first year, an arpent yields at most four pounds of dry saffron; but the second and third year, it rises as high as twenty.

Saffron, to be good, should be very dry, large, and of a bright red colour, clear of the fragments of the petals, or stamina, and unadulterated with extraneous matter: it is not much adulterated in the Gatinois. Besides, its smell should be strong, and it should be absolutely free from the taste of smoke.

The knowledge of the diseases that attack this plant is so necessary to its culture, that we think it incumbent on us to mention them, as well as the methods of curing them, or stopping their progress.

SECT. IV. *Of the Distempers to which Saffron-Bulbs are subject. The Three following are chiefly distinguished: 1. The Tumour, (Le Fauſſet); 2. The Rot, (Le Tacon); 3. The deadly Plague, (La Mort).*

The tumour is an unnatural production formed near the young bulb: it impedes its growth, by robbing it of its nourish-

nourishment. This disease is then, of course, an obstacle to the increase of the bulbs. It is perhaps occasioned by too great an abundance of sap, which causes an unnatural swelling. Before this swelling has made any great progress, the evil may, by amputation, be remedied.

The rot is a decay that attacks the substance of the bulb, and does not shew itself in the coat.

This decay manifests itself by a purple or brown spot, which becomes a dry ulcer; this eats into the substance of the bulb, and at last, reaching the heart, kills it entirely.

The cause of this disorder is not known: it is however certain, that it is more frequently met with in russet, than in black soil; and they say, that it is only within these thirty years that it is become common in the Gatinois.

The only method of curing the bulbs attacked with this disorder, is to cut out the ulcer with a point of a knife, and let the bulb dry a little before it is again put into the ground: but the ulcer must not have penetrated too deep.

Though

Though La Rochefoucault confounds all the disorders of saffron, yet he recommends this remedy; but he would have the mutilated bulbs planted by themselves, and assures us, the greatest part of them will the following year be perfectly sound.

The deadly plague has very remarkable symptoms: it is, with regard to plants, what the pestilence is to men and other animals.

It first attacks the coats, which it renders of a violet colour, and covers it with small threads, or filaments: it then infects the bulb itself, which it totally destroys: the havock it occasions is very perceivable without pulling up the bulbs, for the leaves grow yellow and withered. As soon as a bulb is attacked with this disorder, it becomes contagious, and fatal to the neighbouring roots: the disease is communicated from one to the other, till the infected plants form a circle, of which the first is the center and the focus.

If by chance an infected bulb is planted in a healthy ground, it immediately establishes the disease there, and makes the havock we have mentioned.

And

And this is not all; for a shovelful of earth, taken from an infected field, and thrown on another that is healthy, immediately infects the plants.

There is no remedy known for the bulbs infected with this disease: the only precaution in use, is the method employed to stop a pestilence. For this purpose they dig, in the month of May, round the infected spots, trenches a foot deep, and throw the earth that comes out of them on the dead plants. By cutting off, in this manner, the communication betwixt the healthy and infected bulbs, the progress of the contagion is stopped; which is so great, that in a single year one infected bulb will kill all within a foot round it. There is yet another remarkable circumstance; which is, that the earth becomes so infected, that, if healthy bulbs were planted in it twelve, fifteen, or twenty years afterwards, they would get the distemper.

La Rochefoucault, who, as I have already observed, has confounded all the distempers of saffron, assures us, that when this plant has rotted in the ground, it leaves an infection, and a bad smell, which

con-

continues long enough to rot the bulbs that may afterwards be planted there. The same writer observes, that this rottenness reaches the wholesome bulbs; and adds, that, though trenches may be cut to prevent any communication, yet the surest way is to pull up the infected bulbs; which may be immediately known, on inspection, by the leaves growing yellow, and dying, when they should be green and flourish; and by the flowers not appearing in particular spots.

I the more willingly enquired into the causes of this distemper, as one would scarcely have imagined, that a dead plant should be fatal to all of its species within its reach, or that there were contagious diseases amongst vegetables, for which there is no other remedy than cutting off the communication with the circumjacent plants.

In carefully examining the surface of the ground, I was not able to discover any insect, any kind of moss, any parasite plant, or, in fine, any other particularity, that was not elsewhere to be met with.

I have caused the earth to be dug, to lay the bulbs bare, without finding any thing

thing worth attention. I have found the bulbs in the center, those that occupied the middle space, and those at the extremity of the circle, in three different states, according to the degree of infection.

The bulbs in the center were entirely decayed; their coats were of an earthy disagreeable brown colour; a large quantity of glandulous substances, as big as beans, of a deep red colour, covered them exteriorly; the substance of the bulb was reduced to an earthy matter, in which the principal fibres of the bulb were very perceivable.

The bulbs in the extremity of the circle, which were least infected, had no other mark of the contagion than some violet-coloured fibres, which crossed the membranes of their coats: others had on their coats, or betwixt the lamina that formed them, some of the glandulous substances above mentioned; and on the coats of these bulbs there were only a few violet-coloured spots.

The bulbs that were in the middle space, between the center and the circumference of the infected spots, were in a middle state

of infection; but the earth was entirely traversed by violet-coloured filaments, very fine, and easily broken.

As these glandulous substances, and violet-coloured filaments, were only to be found in the infected spots, I suspected they might be the cause, or at least the effect, of the disease. It was very difficult to detach them from the earth which surrounded them; but I compassed it by repeated lotions.

These glandulous substances have some resemblance to small truffles, but have a downy surface; they exceed not a small nut in size; they have an earthy mushroom-like smell: some of them adhere to the saffron-bulbs; others are distant from them two or three inches.

The filaments are generally of the size of fine wire, of a violet colour, and downy like the glandulous substances: some of them form a communication betwixt these substances; others insinuate themselves betwixt the coats of the bulbs, separate into many ramifications, and penetrate into the body of the bulb, without seeming visibly to enter it. In their way they form num-

berless *anastomoses* * and divisions, interspersed with little knots or kernels, which seem to be nothing but a congeries of the down that covers the glandulous substances, and the filaments.

These observations made me imagine, these tubercles were parasite plants, which nourished themselves with the substance of the bulbs, and, like truffles, encreased within the earth, without appearing above its surface.

It seems certain, that this species of truffle is nourished at the expence of the saffron-bulb, since its roots penetrate the coats of it, and exhaust its substance in proportion to the progress they make.

If we add another observation, which is, that this distemper makes almost all its progress in the three spring-months, I think it cannot be doubted but this unknown parasite plant is the cause of it, since it is at this season that roots vegetate and extend the most. To be certain of this fact, I planted some of these tubercles in pots, where I had before planted, in whole-

Q²

some

* The *anastomosis* is the meeting of the veins, where they join one another, or with the arteries. *Anatomy.*

some earth, the bulbs of various flowers. In about a year they encreased, and infected the roots I had planted with them. I have since that time found, that this same parasite plant does equal damage to dwarf-elder, rest-harrow, asparagus plants, &c. This small truffle supports itself, it is evident, on several plants of very different species. It affects not annuals, nor such whose roots extend near the surface. But, on the other hand, my observations remove all that is surprising in the symptoms of the distemper: it is natural that this parasite plant should extend itself circularly round the infected bulbs, as its progress is made by the extension of its roots, and by the production of new tubercles. If an infected bulb, or a shovelful of earth, will infect a wholesome field, it is because the contagious plant is carried with it: all this is done as it were secretly, as the plant does not appear above ground. The progress of it is stopped by a trench, because the destructive roots are thereby prevented from spreading: and it is indeed the only method that can be used to prevent this mortal disease from spreading over a whole field of saffron.

SECT.

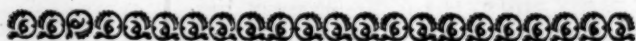
SECT. V. *Of the Uses of Saffron.*

The stigmas of saffron, dried as we have directed, yield an excellent dye. The painters use it for cleaning pictures.

In northern countries there is a great consumption of it for seasoning food. It is in France also used in the kitchens, and enters into the composition of creams, wafer-cakes, biskets, &c. Of it is made usquebaugh, which they use in medicine, in eye-salves, and particularly to keep the eyes from being affected by the consequences of the small-pox. Saffron is an ingredient in all emollient cataplasms: it is esteemed carminative, cephalic, alexipharmic, emmenagogue, cordial, stomachic, vermifuge: it is on account of these qualities that the physicians often prescribe it. Starch might be made of the saffron-bulb; but it would be too dear, on account of the difficulty of getting the bulbs in a sufficient quantity.

Saffron formerly sold for twenty (French) crowns a pound; but it is now worth only from twenty to twenty-five livres; owing either to some other plant being

substituted in its stead, which has lessened its consumption, or to so much of it being raised as to have necessarily reduced its price; for, though the saffron of the Gatinois is still the best, yet there being now much more of the inferior sort, the price of the first must be in proportion lessened.



C H A P. IV.

Of Madder, (Rubia.)

THERE are several sorts of madder used by the dyers. M. Guettard, member of the Royal Academy of Sciences, has experienced that the *ladies-bedstraw*, or cheese-runnet, gallium, will yield it: the plant called *Raye de chaye*, which is used on the coast of Coremandel for dying red, is in fact a kind of ladies-bedstraw. Nevertheless, M. d'Ambournay, member of the Society of Agriculture at Rouen, who has made several useful discoveries on madder, and whom I shall often mention under this head, has not yet been able to extract
a good

a good colour from gallium : in his future experiments he may perhaps be more successful.

The azala, or izari, of Smyrna, which they use at Darnetal and Aubenas, to make the fine carnation dyes on cotton, after the manner of Adrianople, is a true madder : some kinds of it grow naturally in hedges and woods, the roots of which, carefully dried, yield as fine a dye as the azala of Smyrna. M. d'Ambournay has cultivated a kind of madder, which was found wild on the rocks of Oizel in Normandy: the roots of this plant yielded as fine a dye as the azala.

The sort generally cultivated is the *Rubia tinctorum sativa*, C. B. This same kind is raised in Zealand, and about Lille: they dry it, pulverise it, and send it to be sold in France under the name of madder.

It is not possible to give cotton so fine a carnation colour with this madder, as with the azala of Smyrna; but I believe this is not owing to the species of the madder, since the *Rubia tinctorum sativa* has yielded M. Hellot, Member of the Royal Academy of Sciences, as fine a dye as the azala.

We shall at a proper time point out the defect of the madder from Zealand and Lisle: we must first describe the plant commonly cultivated. Madder sends forth stalks from three to four feet long, knotted and rough to the touch (pl. 8. fig. 1.): they are tolerably erect: every knot has five or six leaves springing from the circumference of the stalk, or, as the botanists term it, verticillious: these leaves are long, narrow, and armed at the edges with small hard teeth, which are apt to catch peoples clothes.

The flowers, a, b, c, d, grow at the extremity of the branches: they are composed of a single piece, in form of a cup, perforated at the bottom, c, and divided at the edge into four or five parts: they are of a greenish yellow colour: within are four stamina and a pointal composed of a forked style, e e, arising from an embrio, which makes part of the empalement: this embrio becomes a fruit, consisting of two succulent berries joined together: when the fruit is ripe, every berry contains a seed almost round, f g, covered with a pellicle. The roots of this plant are long, straggling, of the bigness of a goose-

goose-quill, woody, of a redish colour, and they have an astringent taste: this part only is used in dying. M. d'Ambournay, who has raised the Oizel madder, says that it shoots sooner in spring than that of Lisle: he adds, that the small stalks incline to the ground by the time they are a foot long: the leaves of this species are narrower than those of the Lisle madder: the principal difference betwixt these two species of madder is, he farther says, that the roots of the Oizel kind are smaller, of a duller colour, have fewer knots, and are less fibrous than that of Lisle. As it has given in dying a fine colour, that would better bear boiling than that of Lisle, M. d'Ambournay suspects it to be the same kind of madder, as that which is called azala, or izari; for he says, that the seed which he got from Smyrna produced in all respects the same plant; yet the seed brought from the Levant, under the name of azala, produced, in the royal garden, the same kind of madder as that of Lisle. For my part, I suspect the Oizel madder to be the *Rubia silvestris monspessulana major*, J. B.

Mad-

Madder will grow in any soil, but not be of equal goodness. I have experienced, that it is not fond of a dry soil, though proper for wheat; it delights in a substantial earth with a moist bottom; but, if flooded, it dies: I have seen it thrive well in a rich loam on a clayey bottom; and as the clay at bottom prevents the roots from penetrating very deep, they glide as it were on the surface of it, in the moist earth, encrease, and grow very large. They say, that the madder raised in the island of Tergoes in Zealand, grows in a fat soil, clayey, and somewhat impregnated with salt.

M. de Corbeillas had cultivated madder with good success on a kind of bog, more flooded by the rain water, for want of draining, than by the overflowings of the Fusain, a little river which crosses it. Be it as it may, the land is full of large marsh-weeds: and one may reasonably conclude, after the success the plant has had in such a situation, that drained bogs are well adapted to madder.

M. d'Ambournay has raised madder, with tolerable success, on a kind of yellow clay, with a mixture of sand, under which, a spit deep, was a bed of hard gravel: this soil

was

was in all appearances not very good ; but, as it was fresh, M. d'Ambournay perceived, on taking up the madder, that its roots had penetrated into the gravel.

When madder is to be planted in land that is already in tillage, to prepare it for the reception of this plant, it is sufficient to give it a few plowings, the same as if it was intended for corn.

If madder is to be planted on land that is waste and uncultivated, it must be brought into tilth in the manner directed in the Chapter on the breaking-up of wastes, and so managed as to be in good order in April, May, and June. The land being well stirred and manured, it will be necessary to procure plants in the manner hereafter directed.

The first method. It is certain that madder, as well as every other plant, can be raised from seed: for this purpose it must be sown the beginning of May, at a small depth, in beds in the nursery, well dug and manured. When the madder is come up, it must be carefully weeded and watered from time to time. By this means, if the soil is good, and proper tillage has been bestowed on it, after the second year it will
be

be in a condition to transplant into the field.

When this plant is raised in autumn, great spare must be made of the roots. Though this method is not so expeditious as some we shall hereafter mention, yet must we sometimes have recourse to it, particularly when at a distance from madder-grounds.

M. d'Ambournay sowed with good success madder in April and May, part of it in beds as I have directed, and the rest in the open field: he imagines, (therein differing from us) that every thing being in other respects equal, it is more beneficial to sow madder in the place where it is to stand, than to plant sets in the manner hereafter directed. The Lisle madder, which grows very high after the first year, yields scarcely any seed, and upon the whole much less than that of Oizel; numberless flowers go off without seeding: fortunately the sets of this Lisle madder take root more readily than those of the Oizel madder.

Second method. If we live in a province where madder grows wild in the woods, hedges, and vineyards; or if we have a field of madder, the profit of which we are willing

willing to lose for the sake of extending our plantation; we may take up the madder-plants, being careful not to injure the roots, and particularly the runners which extend near the surface of the ground: these plants are then planted entire, observing to extend the runners on all sides. This plant has great numbers of them: three thousand plants are enough for an acre. M. d'Ambournay has put this method in practice, and met with success.

Third method. When madder roots are taken up for the dyers use, many plants may be preserved without lessening the profit; for experience convinces us, that an end or stump of a root will grow, provided it has an eye or bud, and a few fibres: these must be planted in autumn, because, in the common method, that is the season for taking up the roots; but, as a part of these plants generally die, it will be proper to set them pretty thick. M. d'Ambournay met with great success, by planting straggling roots cut into stumps, each having two buds or eyes.

Fourth method. When we have a large quantity of ground in madder, we may procure a great number of sets, without much damage

damage to the madder cultivated for sale : it is to be done in this manner. When the madder has put forth stalks about eight or ten inches long, which generally happens in the course of the months of April, May, or June, in the second year, these stalks are pulled up by women, who take hold of them near the ground : some small roots rise with them, which take again readily, particularly if rain ensues : others of the stalks have only a red foot at bottom ; these do not succeed so well : such as are only green and yellow should be entirely rejected, very few of them taking root.

M. d'Ambournay has planted some sets that had from four to eight inches of yellow roots ; not above a tenth part succeeded, but the sets that were brown and woody at bottom took root well. As care must be taken, in cultivating madder, to make layers to encrease the roots, most of them put forth runners which do not lie very deep : these are drawn up with the stalks when the soil is light, and is moistened with rain : this never injures the madder-ground : on the contrary, when the soil is stiff and hard, most of the stalks break near the surface of the ground, and have no roots. Thus, to
have

have good sets, and not hurt the ground, it is best to use a flatted dibble, about one inch and a quarter wide, which is thrust into the ground to break the layers and raise the earth, at the same time gently drawing the stalks out with the other hand. As this work is slow, it need not be put in practice when the stalk can be drawn with a sufficiency of roots, and without disturbing the layers. Too large a quantity of stalks must not be drawn out of one ground, as it might kill the old plants, if at least a fourth part of their stalks were not left.

These sets must be planted as fast as they are pulled, the ground in which they are to be put having been previously manured, plowed, and harrowed well. As it is the most usual way to raise madder from sets, I shall describe the method of planting them; which will render what I have still to say on the subject more intelligible.

Whilst the workmen make little trenches with a hoe, by a line, about four inches deep, the women and children lay the sets in the trenches at about three inches distance: other workmen cover the sets, by filling the trench with the earth that is raised in making a new trench, in which
the

the women lay the sets in manner above directed.

This second trench is filled with the earth of the third, and the third with earth taken from the interval. In this method the beds consist of only three rows of madder; the rows being a foot distance, the beds are two feet wide; and there is an interval, four feet wide betwixt the beds, in which no madder is planted, but which is stirred in the manner hereafter directed. This method is followed through the whole field; and, supposing it to contain an arpent of land, it will require forty thousand sets to plant it.

In Flanders they make the beds ten feet wide, leaving only one foot or one and a half of interval; but this will appear to be a bad method.

To succeed in a plantation of madder, it is necessary that one set of women should be pulling the sets whilst the workmen are making the trenches, and other women should lay the sets in the trenches, which are instantly covered. As we observed above, that the stalks were pulled to make sets in April, May, and June, it of course follows, that in those months must the madder-grounds

grounds be planted : and, as in this space a fortnight's or three weeks proper weather may be hoped for, a time should be pitched upon when it is inclineable to rain, that the sets may root the better. When pulse is planted in the open field, they are generally careful to have buckets of water at hand to dip the plants in : I should imagine this would be of use in planting madder.

What has been said regards only the planting of sets ; for, as to the pieces of roots with eyes and fibres, being taken up in autumn, they must of course be then replanted ; but, excepting this difference, the beds and intervals may be made as for the sets.

With respect to the rooted plants, they may either be planted in spring or autumn, observing the method we have recommended for the sets, excepting that in this case the trenches must be made larger in proportion to the size of the plants ; the runners must be laid lengthways in the trench, and care must be taken that they are not covered above one inch, or one and a half, with earth, or the stalks will not so readily be put forth from them. But the beds must not be made too wide ; for M. de Corbeilles, having made them with six or

eight rows, found it expedient to reduce them again to three.

About Lisle they take up the sets in May: they take them from an old madder-ground, and plant them by hand in the new plantation. The trenches are about fifteen inches asunder, and three inches interval betwixt the plants in the rows. The beds are made ten feet wide, and are separated by intervals from twelve to fifteen inches wide.

As madder may be transplanted at any time of the year, it is certainly best to take the advantage of rainy weather, either to make a new plantation, or new plant the spots that had failed: but autumn is to be preferred, not only because at that time of the year, as M. d'Ambournay observes, the sets take root better; but also because the sets that are then up are better rooted than those taken up in the spring.

I have observed that madder, which delights in a moist soil, is killed when flooded: this may be prevented by making the intervals lower than the beds; and, on the contrary, when the soil is too dry, it would not be amiss to make the intervals higher than the beds. It is true, this disposal of them does not continue long, because, as will be hereafter observed, the intervals must be

lowered to raise the beds : however, it will still be of some use to the young plants.

The work in a madder-ground might be much lessened, if it was planted with plants raised from seed, or with sets : for this purpose a trench is made with a plow ; women lay the plants in the trench, observing to lay the sets all the same way ; the plants are then covered by making a second furrow. No sets are put into this furrow ; it is filled by drawing a third, in which sets are put, which being covered, completes the bed, which in this method contains only two rows of madder.

If the madder was planted in autumn, it will be sufficient to give it, from time to time, a few slight stirrings with a light plow ; and, as these stirrings are more intended to loosen the earth within reach of the plants, than to give them vigour, they should not be given when the weather is wet, and the earth apt to knead and clod. Before the months of June or July a slight stirring should also be given to the intervals of the madder-grounds planted in spring.

At Lisle they give all the plants a slight tillage with a very narrow instrument ; and at this time they lay down on all sides the new shoots, which they slightly cover with earth.

When the shoots of madder are a foot long, the beds are weeded by women: afterwards the earth of the intervals having been well stirred close to the beds, the workmen lay, on the earth of the intervals, part of the stalks of the first row, and cover them one inch and a half, or two inches, with the loose earth of the same intervals: hence results the great advantage which M. de Corbeilles has derived from plowing the intervals, the earth being thereby loosened, and made ready to cover the layers; which in the method followed at Lisle is with great difficulty performed, as well as when the earth is suffered to grow hard.

In this operation it will be necessary to take great care not to cover the layers entirely with earth: their extremity should be uncovered, or the whole branch would die; but, this point attended to, the tender stalk that is covered is converted into roots.

It will be some time before these branches, converted into roots, will have so good a colour as the true roots: it is on this account that I would not recommend all the shoots to be laid down, but that some should be left to every plant, which by that means will be more vigorous, and produce finer roots. I have in various parts of my works
made

made it evident, that plants multiply their roots in proportion to their productions above the surface of the ground.

When there are three rows on every bed, the second should be laid down betwixt the plants of the first, as we have directed: the layers being covered two inches thick with earth, the branches of the third row are laid betwixt the plants of the second, and are covered: by this means the bed is made a foot wider at the expence of the interval.

When there are but two rows in a bed, the one is laid to the right, and the other to the left: this widens the beds two feet, and the intervals are made in proportion narrower.

To do this work expeditiously, after having stirred the intervals with a common plow, on each side close to the beds a small furrow is to be formed, to receive the layers, which are to be lightly covered with a hoe: this does not take up much time.

In years that are very favourable to the growth of madder, it sometimes happens that these layers have shot a foot in length: the work above mentioned may then be repeated, and the beds are a second time widened at the expence of the intervals. It is but seldom this happens; but when it does,

in every layer a vertical sprig must be left uncovered, for the perfecting the roots, which, being the useful part, should most engage our attention.

M. d'Ambournay is of opinion, that the layers do not yield near so great a quantity of dye as the true roots : for this reason he would not have the stalks of this plant laid down, but rather that they should be planted close together. I do not condemn this method ; but it is always of service, besides the stirrings that are from time to time to be given, to earth the beds in March, before the stalks appear : this makes it necessary to have proper intervals. I can indeed affirm, that in good land, the layers, after a proper length of time, will turn into roots that are not hollow, and of a fine colour.

Finally, to make the culture of madder in some sort resemble the other methods to which the countrymen are accustomed, M. d'Ambournay caused some of it to be planted or sowed under furrows in rows like kidney-beans. Madder must be hoed and earthed-up in the same manner kidney-beans are ; and this way succeeded best, as the countrymen had only to follow their old track. To please such as cultivated this
plant,

plant, and were unwilling to lose a crop, M. d'Ambournay caused a row of madder to be sown, and a row of kidney-beans alternately, that the two plants might come up at the same time, as they required the same culture; and that, after the crop of beans was off, the land might be left for the madder. I know not the result of this experiment. But to return to the old culture.

The stalks of madder should never be pulled up the first year, particularly such as are connected with the layers: as they have not yet put forth many fibres, they would be pulled entirely up: they might indeed be cut, but they had better be left to die of themselves.

At Lisle they have a custom of digging the path one foot and a half, or two feet deep, in order to lay the earth on the beds, in the month of March in the second year.

In April, May, and June, if they are in want of plants, they pull the sets in the manner above described; after which the care of the madder-ground till August consists only in weeding it, and giving the intervals a few slight stirrings with the plow: but it would not be amiss also to hand-hoe the middle of the beds, on which there are

but two rows; this will be of service to the roots.

In September the madder-stalks may be cut and dried. At Lisle they mow the madder in August; and it is on this account that the people of Flanders assert, that madder bears no seed that is fit for sowing; and M. d'Ambournay also says, that the Lisle madder bears no good seed the first year. The dried madder-stalks are excellent fodder for cows: the feeding on them makes the cows give a great deal of milk, of a colour inclinable to red; and the butter made of it is yellow, and well tasted.

If seed is wanted for sowing, the madder must not be mowed till it is ripe.

When this work is done, it will be proper to give the intervals a slight stirring, to keep them in good tilth; for it is on them the beds are to be formed the following year.

I should observe, that when the crop of madder is taken up, and the soil unoccupied, it must be tilled throughout, to prepare it for planting, as at first. Care must be taken to form the beds in the middle of the former intervals, and in other respects the directions given for the first plantation must be observed. Eighteen months
after-

afterwards, when the second crop of madder is off, if this same land is sown with corn, it will yield abundant crops; for, besides the madder's not impoverishing the land, the frequent stirrings required in its culture prepare the field admirably for any future production: yet, if after a term of years it is thought proper to plant the field again in madder, the land must be well dunged the year before it is planted.

The roots are the useful part of madder; it is these that must recompense the planter for all his trouble and expence. These roots are taken up in October or November.

It is a general complaint, that the peasants about Lisle, being in too great a hurry to enjoy the fruits of their labour, take up their madder before the roots have attained a proper size; the Zealanders let their madder-roots grow larger. A medium is however to be preserved; for an old root, that has been long in the ground, yields less dye than a young root, that is about as big as a large goose-quill. But, if the roots are too small, it will be more profitable to wait another year before they are taken up, or they will be of little use. In this case
the

the beds should be hand-hoed in February or March, before the madder shoots, and supplied with fresh earth from the intervals, and manured with sheeps dung.

The most expeditious method of taking up this root, is to run a cultivator along the beds without a coulter: the women who follow, pull out the roots, and put them into their aprons as fast as the men break the clods with hoes, &c.

Another method, which is more troublesome, but damages the roots less, is to turn the earth of the beds into the intervals with a three-pronged fork: if it turns up in clods, the workmen break them, and the women gather up the roots, either in baskets or their aprons.

If the roots are taken up in dry weather, there is no occasion to wash them; but, if the earth is moist, they must be washed, which should be avoided if possible; for the colour of the water shews that it takes away part of their quality: it is better to clean them with the hands: the kiln and the flail, as we shall in due time observe, will complete their cleaning.

Unfor-

Unfortunately the tap-roots, which are often the best, and of which there are besides a great number in deep soils, cannot, as M. d'Ambournay observes, be extracted by any of the methods above recited. The layers have not this inconvenience, and the roots of the sets run much less to tap-root than the plants that are raised from seed.

As the roots are gathered up, they are spread on a dry pasture; for, whilst there is wind and sun-shine, it is most expedient to take all advantages of beginning to dry them before they are housed. To prevent any loss in carriage, they line the waggon with a thrashing-cloth. As fast as they are carried in, they are spread on barn-floors, or under penthouses, and as soon as possible put into the kiln to be sufficiently dried, that they may run no risk of fermenting or rotting. Some of the kiln-expences might doubtless be saved if the roots were partly dried in the field; but to do this it would be more proper to take them up in the spring, when the sun has more power than in autumn.

As it is a large expence to build a kiln, and as in each district there are but few that can afford to lay out so much money,
such

such as have none generally sell their roots to those that have.

Madder-root is with difficulty dried: its sap is viscous, and it loses in the kiln seven eighths of its weight.

As I propose treating of the kiln at large, it is sufficient to observe at present, that it must be heated till one of M. de Réaumur's thermometers points thirty or thirty-five degrees above Zero. I do not however imagine, that any inconvenience would ensue, if that degree of heat were exceeded; on the contrary, I am apt to think that the Zealanders exceed it much. But we may lay it down as a general maxim, that it is better to leave the madder longer in the kiln with a moderate heat, than hurry its drying too much: some small experiments induce us to think that the madder would be of a better quality, if it could be entirely dried in the sun, or even in the shade by the sole action of the air upon it, which, they say, is the practice in Smyrna, where the air is much drier than in Flanders.

I imagine, that if madder was taken up in the spring, the hot weather would extract a great part of the moisture of the roots; and by this means the charges of drying
in

in the kiln would be greatly lessened: the only inconvenience is the difficulty of procuring workmen at that time of the year.

I would recommend, that as soon as the roots are taken up, they be carried into the neighbourhood of the kiln, thinly spread on a level grass-plat, well exposed to the wind and sun, and from time to time turned: it will be also necessary in rainy weather, as well as every night, to put them under penthouses; and, that there may be no occasion for very large sheds, it will be best not to take up all the roots at once, but in parcels, in proportion to the accommodations there are for drying. It is on this occasion the planter should vary his methods of practice according to the weather: if the dry weather seems likely to hold, he should take up a great quantity of madder, and take advantage of the weather, as it will be a means of saving him much trouble and expence: if the weather is wet, he must only take up the quantity he can conveniently house and dry in a few days.

M. d'Ambournay has dried madder in the sun, and obtained fine dye from it: he approves much of the method we have

prescribed; he is of opinion, that no roots should be taken up in autumn but such as are wanted for planting, and that it is better to put off till spring the taking up what is intended for the dyers, that all possible advantages may be taken of the hot sun and drying winds, to save the expence of kiln-drying.

In the common way it is not enough that the madder is dried so as to keep, but it must also be reducible to powder.

Madder is dried enough when it breaks short on being bent: but it must be observed, that it continues to dry, if, after being taken out of the kiln, it is spread thin on a dry floor; for the moisture of it goes off in vapours.

Before the roots are entirely cold they lay them on close wicker hurdles, and thrash them lightly with a flail: they are then fanned, to separate the larger roots from the fibres, and also from a part of the outer bark, and the fine earth, which the heat of the kiln has caused to separate easily from them. All these substances, which might hurt the colour of the dye, fall either under the hurdles, or to the bottom of the fan. The small roots, divested of their outer bark,
may

may be rejected as uselefs, though in Holland they do not suffer them to be waſted; for they uſe them in ordinary dying.

M. d'Ambournay has communicated to me a method of peeling madder, invented by M. Pagne, of Darnetal. They put the madder-roots, after being picked clean and dried, into a large ſack of coarſe cloth: in this they are violently ſhaken; and the rubbing of the ſack, and that of the roots, one againſt the other, almoſt entirely detaches the outer bark, which is completely ſeparated in the fanning: by this means fine roots of peeled madder are procured, as ſuperior in effect to the azala, as that is ſuperior to the beſt Dutch madder. But this is not to be done, except the dyer is curious and nice enough in his practice to give a price in proportion to the expences it occaſions.

M. d'Ambournay poſitively aſſerts, that if madder is taken up in ſpring, and the weather is tolerably favourable, the roots may be dried in the ſun ſo as to keep without the uſe of the kiln; which is ſaving a great expence.

I have had no opportunity of making experiments extenſive enough to ſupport
this

this assertion; and, when I thought of drying madder in the sun, it was only to lessen the expence of the kiln, which I think however very necessary.

M. d'Ambournay adds, that, to accelerate the drying of the madder roots, he spread them on a kind of brick floor. If this method of drying succeeds in large concerns, the world will be much obliged to this gentleman: but we shall in due time mention another discovery, which we think still more useful.

Compact light soils bear better madder-roots than such as are very rich and moory. The land should not only bear roots of a good quality, but in sufficient quantity to repay the planter his expences, and recompense him for his trouble. According to an experiment made near Tours, an arpent of one hundred perches (each perch twenty-two feet) produces eight thousand weight of green roots.

The first experiments of M. de Corbeilles yielded at least as considerable an increase. In the year one thousand seven hundred and fifty-seven, half an arpent yielded in the same proportion, bearing a crop almost as large as three arpents and
a half

a half yielded in many places in the neighbourhood. But it is very seldom that an arpent bears so much as eight thousand weight of green roots; one arpent with another, not more than four, five, or six thousand weight can be expected from an arpent.

When the madder comes out of the kiln, it may be sold to the dyers: some rather chuse to buy it in the root, or, as it is generally called, in the branch, than ground. But, as this root easily imbibes moisture, it should, when it is taken from the kiln, be laid close and regularly in barrels, which are to be immediately headed. In this state the madder may be carried to market, or, if it is not to be carried far, it may be put into sacks.

Such as propose to reduce the roots to powder, send it immediately from the kiln to the mill; but, as they cannot be ground as fast as they are dried, they are put into sacks, and laid in a dry place, for instance, under the kilns, till the mill is ready to receive them; and this should be as soon as possible.

Before I describe the method of grinding this root, it will not be improper to give

an account of an important discovery made by M. d'Ambournay. Not being able to dry the roots he had taken up about October, with a kiln, he determined to use them green. He began by washing them, to take off the earth; and, as he had formed an opinion that this root loses, in drying, seven eighths of its weight, he imagined that eight pounds of the green root should be used in a bath, that would have taken only one pound of the dried and pulverised root: he beat this green root in a mortar, and using rather more water than common, he dyed some cotton in the customary way. Finding that the bath still retained a great deal of colour, though the cotton had imbibed so deep a dye, that it underwent two boilings to reduce it to the usual colour, he repeated his experiment, and found that four pounds of green madder have the same effect as one pound of root dried and pulverised: whence he concluded, that half the madder which is commonly used might be saved. This however is not the only saving.

1. There is no occasion to build kilns, or sheds.

2. There

2. There is no loss from drying it either too much, or too fast.

3. The waste and expence of peeling and grinding the root is saved; as, when these are done, all the roots that are no bigger than packthread are wasted.

4. The mill-expences are saved, as well as the waste and fraud that is practised at it, and the inconvenience of waiting till it is at liberty.

5. Finally, the roots do not evaporate and ferment, as they do when they are ground, unless immediately used.

All these advantages taken together may amount to a saving of five eighths at least. The planter that knows how to dye, can put his knowledge in practice as soon as he has roots large enough to be taken up; and the dyers by trade will by degrees be sensible of the advantage, and share the profit with the planter, when madder-grounds are near them; for, as madder has no particular time of maturity, when the planter carries a parcel of green roots to the dyer, he will be sure of a market for them in that state, without being subject to a trouble, which, though in itself not very considerable, is dreaded on account of its

novelty, or to an expence that he can by no means afford. The dyer can buy his root daily, as he wants it, in proportion to his consumption; or he can let the farmer know the quantity of madder he shall want, and the time it shall be sent to him.

This experiment, besides reducing the price of dying, will be a means of reducing the price of our goods at foreign markets.

In all I have said I have made use of the very words of a paper, which M. d'Am-bournay was so kind as to send me. I shall only observe, that, as there are many cases in which there is a necessity for drying madder, when it is to be sent any considerable distance, it will be necessary to take notice of the method of drying its roots; but I shall first point out the marks by which good madder may be known, either in the branch, or in powder.

Merchants and dyers should know the difference betwixt good and bad madder. But we shall impart our knowledge in this matter for the sake of the planters, were it only to guard them against the ill-founded assertions of the buyers, who are very apt to depreciate it, to get it the cheaper.

This

This root, which is one of the best ingredients that can be used for dying wools and stuffs, gives them a red colour, not very bright, it is true, but which resists, without alteration, the influence of the air, the heat of the sun, and the effects of the ingredients made use of to try colours: it contributes also to make other mixed colours lasting: finally, a method is found out of giving cotton a very pleasing and lasting carnation colour with it. All parts of the root do not yield this red; the dye of some parts fades, other parts are worth nothing at all.

In examining a well-conditioned root of madder with a microscope, under the outer bark in the flesh may be perceived certain red particles, which certainly yield the colour which the root contains; but there is, besides this, seen a great quantity of woody substance of a fallow colour; and this substance probably impairs the first-mentioned colour. According to M. de Tourniere, this fallow colour is not so good a shade as the red; and he imagines that lyes, &c. give a brightness to the colours dyed with madder in no other respect than by abstracting this fallow colour. The sun and dews have

the same effect on yarn dyed with madder, when it is exposed on the grass.

M. de Tourniere also imagines, that the part which yields the red, is, in the green root, dissolved in a mucilaginous juice; for the bark, and the other parts which contain most red, are also most succulent: by drying them in a kiln they lose seven eighths of their weight, and yet the roots are not perfectly dry; for they bend before they break; they are rather bruised than ground by the mill; and this unctuous powder is apt to clot: it is true, that in time they lose this unctuousness, and become dry; but at the same time the quality of the red particles is lowered. These observations are well deserving of attention; for they make it evident to us, that these valuable particles may be impaired by too great a heat: supposing it unctuous, were it too much dried, perhaps water would not dissolve and separate its parts. Finally, these reflections of M. de Tourniere agree very well with the experiments of M. d'Ambournay, and convince us that madder-roots may be used green with very considerable advantage. But green madder can never be used, except when the grounds lie convenient for the dyers;

dyers: thus, when madder is to be carried to any considerable distance, it must of course be dried, and pulverised. I shall resume this subject.

1. As madder-roots are very apt to ferment when they are bought green, it will be necessary to examine carefully whether they are spotted, or have a musty smell: if the fermentation has given them a black hue, they are by all means to be rejected.

2. The roots to yield a fine dye should be fresh: such as are dusty on being broke must therefore be rejected, and with still greater reason those that are rotten and worm-eaten: on the contrary, such ought to be preferred as have a strong smell somewhat like that of liquorice: the ground-madder should be unctuous, and run into clots on being handled.

3. As madder is sold by weight, it is an advantage to the purchaser to have the roots quite dry; but he should be careful that they have not been kiln-burnt: such as have a strong smell have seldom this defect. Too hasty a drying wrinkles and splits the bark; and, as it then separates very easily from the wood, the most useful part is lost: the bark therefore should be smooth, entire,

and adhering to the wood : but we must not confound the true bark with the outer bark, or epidermis, which would only lessen the brightness of the colour.

4. The largest roots are not always the best : they are frequently yellow, and have but little of that red part which alone yields the colour. The very small roots are of little value, as they have too much outer bark, which hurts the colour : but those of the best quality are from the size of a goose-quill to that of the end of the little finger.

5. In breaking the roots there may be seen, as I have already observed, two substances differing one from the other : that which inclines to a yellow only, hurts the dye : that of the deep red is the part really useful ; consequently the highest coloured roots should be preferred.

It would be a useful discovery could there be a method found out of extracting the red particles without any mixture with the fallow or yellow part : I am of opinion the trials should be made on the green root, that the red particles, which are then in a state of dissolution, may be more easily extracted.

6. As

6. As the surest method of knowing the quality of madder is to make a trial of it on some piece of stuff, it will not be amiss if such as plant much of it accustom themselves to make this trial, that they may demonstrate to the purchasers the quality of their roots: the following process for doing it, is extracted from the works of M. Hellot.

To dye a pound of woollen yarn, a bath must be made with five ounces of allum, and one ounce of red tartar, dissolved in a sufficient quantity of water: the wool that is to be dyed must be well drenched in this liquor: in about a week half a pound of ground madder-root is to be thrown into water as hot as you can bear your hand in; and, after having mixed the water and powder together with a stick, the wool is put into it; and the bath must be kept hot for an hour, but not boil; for, if it did, the colour would be dull: but towards the end of the time the bath is made to boil; but the yarn must be instantly taken out.

As very trifling circumstances will affect the beauty of the colour, it will not be amiss to make at the same time two trials with the same yarn; one with the madder that

is to be proved, and the other with the fine madder of Zealand, or azala: the beauty of the skains will determine which is the best madder.

As these trials may as well be made on two or four ounces of yarn as a pound, the baths may be made accordingly. I shall now treat of the methods of drying and pulverising madder.

We have observed that green roots are very apt to ferment: it is therefore necessary to abstract the great quantity of moisture that causes it. If the weather is very dry and hot, it is certainly adviseable to take the advantage of it to dry the roots in part, and save wood; but, if the weather is damp, the roots must be spread under sheds, or on barn-floors, and often moved; for, if they were laid in heaps, they would soon heat, and change, more or less, according to the state of fermentation they were in. With care the fermentation of the roots may be greatly lessened; and, according to M. d'Ambournay's opinion, they may even be kept good for some time; but the roots cannot by these means be made dry enough to preserve them from any change. For small crops a common oven will serve; but it must

not be heated to above forty-five or fifty degrees of M. de Réaumur's thermometer. But this method is very tedious, and it would require very large ovens to supply the place of kilns. To save the expence of building a kiln, I would recommend the making a place over the roof of the oven, to put the roots in, that they may begin to dry : but, if we grow much madder, it is absolutely necessary to have a kiln proportioned to the quantity that is to be dried, not only of our own crops, but those of the peasants that cannot afford kilns.

The kilns may be made of very different forms, many of which are of equal goodness ; but, when a man proposes building one, he should be attentive, 1. That it may contain a large quantity of roots ; 2. That it may be worked with ease ; 3. That as little fuel as possible may be used ; 4. And that it be so contrived as to retain an equal and moderate heat. To make these matters easy to planters, we shall describe the kilns that have been long in use at Lisle for drying madder-roots: we shall point out their defects, as well as the defects of two kilns that were successively built at Corbeil ; and lastly we shall

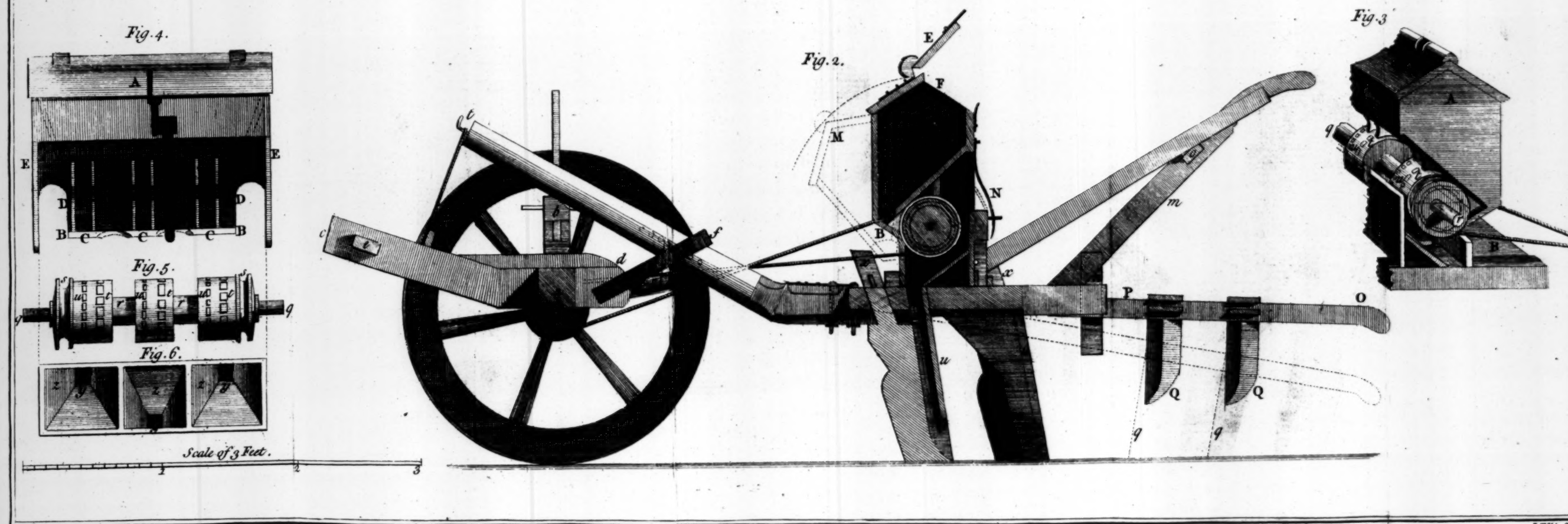
shall mention the attempts we have made to improve and perfect them.

SECT. I. *Description of the Lisle Kiln.*

This kiln differs very little from that used for drying malt. To have a general idea of it, we must suppose there is a large furnace, in which a great fire is made; this furnace is made under an arch: the hot air and smoke pass through a funnel over the furnace, and spread themselves in a space in form of an inverted pyramid, the bottom of which is covered with a perforated floor, on which the madder-roots are spread. This is the general form of the kiln; but I shall give a description of it according to the figures in the plate, for the use of such as intend to build one.

The figure 2. pl. 8. represents the section of a building containing a madder-kiln.

In this building may be seen a vault, K K, a ground floor, L L, and a first story, G G, over which we are to suppose a granary, H. The foundation of the brick-work of the kiln is somewhat lower than the bottom of the vault; the walls terminate in arches at the bottom of the first story; the side-walls
of



of the building serve as upright supporters; and the arches of the kiln are sustained by jams which are put into the side-walls. All this will be better understood by explaining the letters of reference.

A, (pl. 8. fig. 2.) an ash-hole two feet wide, three feet and a half deep, and two feet three inches high. B, the furnace with an iron grating, b b, at bottom: C, a pricked line, which determines the height of the furnace door; this aperture is sixteen inches wide, and seventeen high. D, the chimney. E, the perforated funnel, which disperses the heat by means of the holes i i i. It is to be observed, that this chimney is entirely covered at the top, to prevent any thing falling into it. I I I, holes two inches square, by which the heat escapes; they are placed chequerwise. F, an empty space into which the heat goes out of the funnel before it reaches the upper story, G. G, a floor set with square tiles, on which the roots are to be spread one foot and a half thick*. These tiles are fifteen inches long, ten or eleven wide, and two thick: they are perforated with conic holes, as here represented.

* Madder must be from time to time stirred with iron forks, that it may dry equally.

sented. H H, tubes four inches wide, by which the superfluous smoke escapes, and through which fall the dusty particles that drop through the holes in the tiles of the floor G. These tubes are stopped by a little iron door, which is opened when the heat is too great.

K, the vault in which the fuel is kept. L, places where the undried madder is safely kept. M, iron joists two inches thick, traversed by bars which bear the tiles that compose the floor. N, iron braces fixed to the beam P, to support the floor G. P, the beam of the second story. Q, a casement, or window, to be opened at the beginning of every drying, to let out the smoke. When the madder begins to dry, these casements are shut, to keep in the heat. There are also in the second flooring two trap-doors, which are opened to let out the smoke and steam.

Fig. 3. represents the plan of the furnace. The three iron bars which cross it are each two inches and a half broad, and six lines thick; they are let into the walls three inches: the bars of the grating are one inch square, and rivetted to the other bars. In this plan are to be seen the
tubes

tubes marked H, to shew that they run the whole depth of the furnace. These tubes are very necessary to convey into the kiln the heat from the body of the furnace.

Fig. 4. represents the plan of the tiled floor, G: it is sixteen feet square.

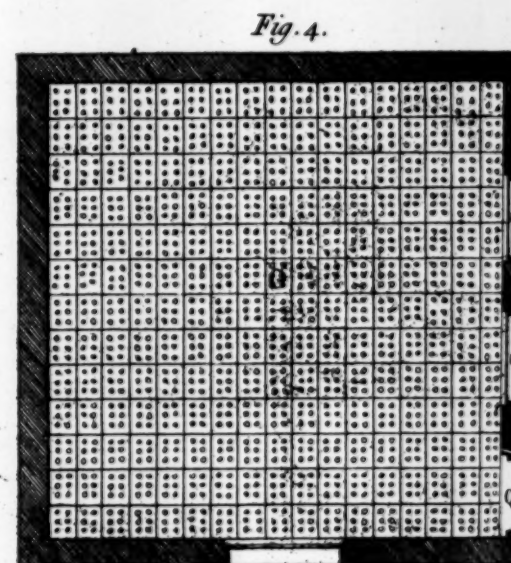
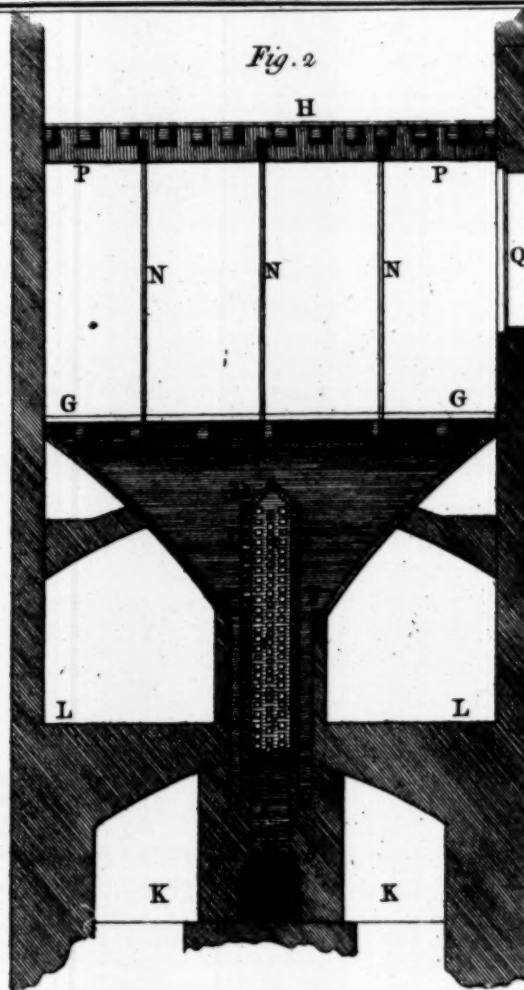
As the furnace we have described resembles that used for drying malt, I was willing to observe in what manner it was dried, and remarked that they lay it about nine inches thick, and that it is very hot at bottom. When M. de Réaumur's thermometer was applied, it rose upwards of twenty-two degrees above Zero; but the upper part, being influenced by the external air, heats but little: the steam that rises, being condensed by the cool air, is reduced to water, which occasions the upper part of the bed of malt to be always wet: for this reason it must be often turned. In this method, by being often wetted with the steam, the bed of malt is much retarded in its drying. I imagined this inconvenience might be removed, by preventing the external air from affecting the surface of the bed: and this would be effected by making a covering for it; and, if this covering could be fixed within a foot of the malt,

malt, another advantage, which I shall mention, would result.

It is well known in physics, that the vapours which arise from heated matter have a great power of penetrating and heating the matter whence they proceeded, provided they are collected, and in some manner reverberated on the matter to be heated; it is on this principle the machine was constructed in which the bones of animals could be dissolved; and we know that, in an equal degree of heat, water has eight hundred times more volatility than air; and vapours or steam contain a great deal of water †.

This induced us to think that it would be of great use to reverberate the steam on malt and madder roots, by means of the covering above mentioned. M. Villot, a brewer, at Paris, who takes all opportunities of improving his beer, has made some experiments of this nature, and in part succeeded. It is only necessary then to contrive a method of putting this in execution

† We could relate many experiments, which we have made to soften wood by the steam of water. But we chuse to refer to those related in the Treatise of Husbandry.



ecution in a large building: of which we shall in due time take notice.

One great defect of the Lisle kiln is, that the smoke, mixing with the roots, charges them with fuliginous matter, which probably hurts the colour, and is perhaps the cause of the difference betwixt the Levant madder and that of Lisle, these last being by no means fit for dying cotton as done in the Levant: besides, in these kilns the workman cannot properly regulate his fire: these defects might be removed by making the middle close, and terminating it in a tube of cast or hammered iron to carry off the smoke: the floor, supported by iron bars, might very well be dispensed with, and instead of it one of wood lattice, wicker work, or iron wire, would do; for, the funnel once properly secured, there would be no danger of fire. In order to enable every one to vary the construction of these kilns, we shall add some reflections and observations made with great care by M. de la Levrie, who superintended the building of two kilns at Corbeil.

SECT. II. *Remarks on the Kiln used at Lisle.*

It will not be amiss to begin by relating the experiments made with two kilns, built one

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after the other at Corbeil, to dry madder, as thereby the advantages of that herein after proposed will be more evident.

The first of these kilns was twenty-one feet long, twelve wide, and ten feet high: within-side it was surrounded by three stages of hurdles, like shelves, four feet wide, and twenty inches one from the other; the first stage was five feet from the ground: on these stages the green madder was laid eight inches thick. In the upper floor was a trap-door, which opened to let out the steam of the root. The furnace, which was not without defect, went three feet within the kiln: it was supplied with fuel from without: within-side it was furnished with metal tubes, which passed through the fire: these tubes received at one end the outward air, which they discharged within, very hot, by an aperture two feet from the ground. The effect produced from this kiln, was as follows: the three stages being filled with roots, those on the upper stage became dry enough to send to the mill. It is true, they dried but slowly, because the steam, which proceeded, though in no great quantity, from the two lower stages, wetted the under part of the hurdles of the first stage,

stage, thereby retarding the work. The heat, which was not powerful enough to raise all the moisture of the madder-root on the lower stages in steam, made them sweat abundantly, so that the under parts of the hurdles were covered with drops of water as big as the finger's end, which fell from the second shelf on the first, where they wetted the root; and from the first shelf they fell to the ground. On the upper shelf were very few of these drops of water, except for a very small space of time after the kiln had fresh roots put into it, because at the upper part of the kiln the heat was powerful, and regularly dispersed, whilst at the bottom it was cold. At each stage was fixed one of M. de Réaumur's thermometers: after four days continual fire the lowest scarcely rose to eighteen degrees; the second, somewhat higher; and the uppermost never passed eighteen degrees, which is thought sufficient, when the drying is not retarded by any steam from below. When the dried root was carried to the mill, the root from the second stage, which had lost part of its moisture, was removed to the third, and that of the first stage, still wet, was laid on

the second, the first stage being filled with fresh roots. The lowest thermometer then fell to fourteen degrees, and the uppermost to Zero: this induced them to dry all the roots that were at once put into the kiln, before they admitted any fresh; yet even in this method it was necessary to move the roots from the lower to the upper stages, where the last laying dried faster than the others. As this work was tedious and troublesome, it was determined to take down this kiln, and build a new one, now in use.

This second kiln is of the same length and breadth as the first; but the hurdles on which the madder is put are raised only six feet from the ground, and the apertures of the furnace, which supply the hot air, are level with the ground: they, besides, continued to avail themselves of the mistaken advantage of encreasing the surface to contain more roots, by making, as in the first, three stages of shelves. The roots indeed dry in it faster, because the furnace yields more heat; but this heat is very unequally dispersed at the different heights, and in the different parts of the length of the kiln, because the same inconveniences
still

still subsist, as they have made in it, like the other, three stages, one above the other, and they have formed the kiln long, without letting the furnace extend through its whole length. They have besides placed the first stage too near the fire; but this may be remedied by taking it entirely away, and using only the uppermost stage, which is fifteen feet from the bottom of the kiln, and may extend over the whole of it: the heat will then be more regularly dispersed. The roots may be laid fifteen or eighteen inches thick, and may be much easier attended to than on the shelves, which occasion a great deal of trouble: there might also be two furnaces, one at each end of the kiln, and the tubes might be carried over the whole length of it.

From what has been said, we may conclude, that to dry a plant like this, which contains a great deal of moisture, no advantage can result from having a kiln with three stages, one hurting the other; since the heat tending always upwards, the roots must be moved higher, which cannot be done without trouble, loss of time, and expence; whereas, the same quantity may

be dried in less time on a floor raised eighteen or twenty feet above the furnace.

It is certain that a peasant, who raises madder after a proper method, will always be a greater gainer than such as are obliged to hire day-labourers; but the peasant cannot go to the expence either of a kiln, or a mill; it must be planters who raise large quantities of it, and can afford the expence, that have them: thus, it is to be presumed, the peasants will be under a necessity either of selling their roots green to the dyers, of taking them up in spring to dry them in the sun, of drying them in their ovens when they have only a small quantity, or, finally, of carrying their roots to the kiln, as they do their grapes to the press.

The Lisle kiln, though built on a good principle, is too expensive for a young planter. There must be strong walls to support the arches, internal abutments, and bricks to build the arches with. In some provinces, there is not a workman capable of turning an arch in brickwork. The floor requires many large iron bars. On the other hand, a kiln in the form of an oblong square, like that at Corbeil, will never heat equally in its whole extent,
unless

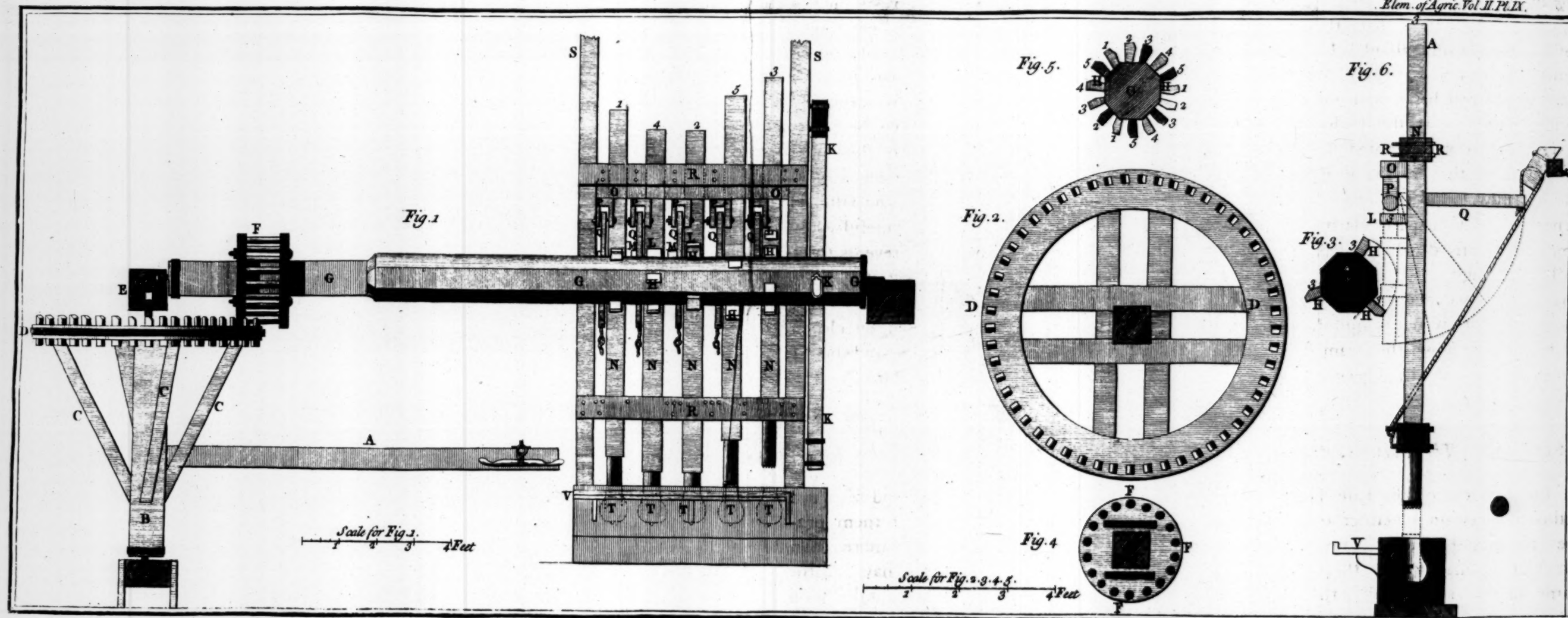
unless tubes be made to convey the smoke through various parts of the kiln, before it reaches the chimney, or there is a furnace at each end. All this is expensive, and subject to inconveniences.

Perhaps then a kiln somewhat resembling a malt-kiln would do; and this might any where be built at a small expence: such a kiln need not be above eighteen feet square, and eighteen or twenty feet high from the ground to the floor. Underneath the floor should be a reversed pyramid, somewhat obtuse at bottom, to receive the funnel and tubes that are to give the supply of hot air: this may be made with quarter-stuff covered with lath and plaister. This kiln does not require any very large furnace. The new kiln at Corbeil is much larger, taken from the second stage to the bottom; yet has the heat been brought there to upwards of forty-five degrees. The floor of the kiln is to be made with joists eight inches by four, covered with laths, grating, or with hurdles as at Corbeil, where it has already lasted six years: there must be walls to support the roof and beams, and it should have two windows: there should be a plaister floor,

eight or nine feet above the grating, with one or more trap-doors, as they let out the steam much better than the windows: lastly, the beams should be plaistered. There is reason to think that such a kiln would cost little, and answer the intended purpose. It should have been observed, that over the grated floor should be laid a large thin cloth, or rather a hair-cloth, rising round the edges, and fastened with nails: this is particularly useful when small roots are dried, as it prevents their falling through. A foot above the roots may be put wooden traverses, over which may be laid straw matts quilted on cloth: this will keep down the steam, and be of great service, as has been already observed.

SECT. III. *The Furnace of this Kiln.*

The furnaces of the Lisle and Zealand kilns are certainly neither of them proper for drying madder, any more than those of the malt-kilns: they have all the same defect, as they fill the kiln with smoke, which damages the roots. It was this inconvenience induced us to endeavour



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vour to contrive one that would give a great deal of heat, without the above defect *. This may be probably effected, by not letting the funnel be perforated, and carrying tubes from it which should run under the madder before the smoke was discharged; and by having other tubes run near the fire, to circulate in the kiln a warm air, which they should receive from without. I have made the trial of such a furnace, and confess it did not yield sufficient heat: the furnace should certainly have been made larger; but the expence is a continual objection, which, besides being considerable, is pure loss to one that makes experiments for the public good, without being in a situation of reaping any profit from them. I shall close then what I have to say on madder-kilns, by concluding, that malt-kilns seem well adapted to the purpose, but some method must be found to prevent the smoke damaging the roots.

Madder, being well dried and cleaned, may be sold in that state to the dyers; but,

* M. M. Hellot and d'Ambournay have made as fine dyes with the Lisle madder, as with the azala, by only preserving the root from being damaged by the smoke.

but, if it is to be pulverised, there will be occasion for a mill, which I shall now describe.

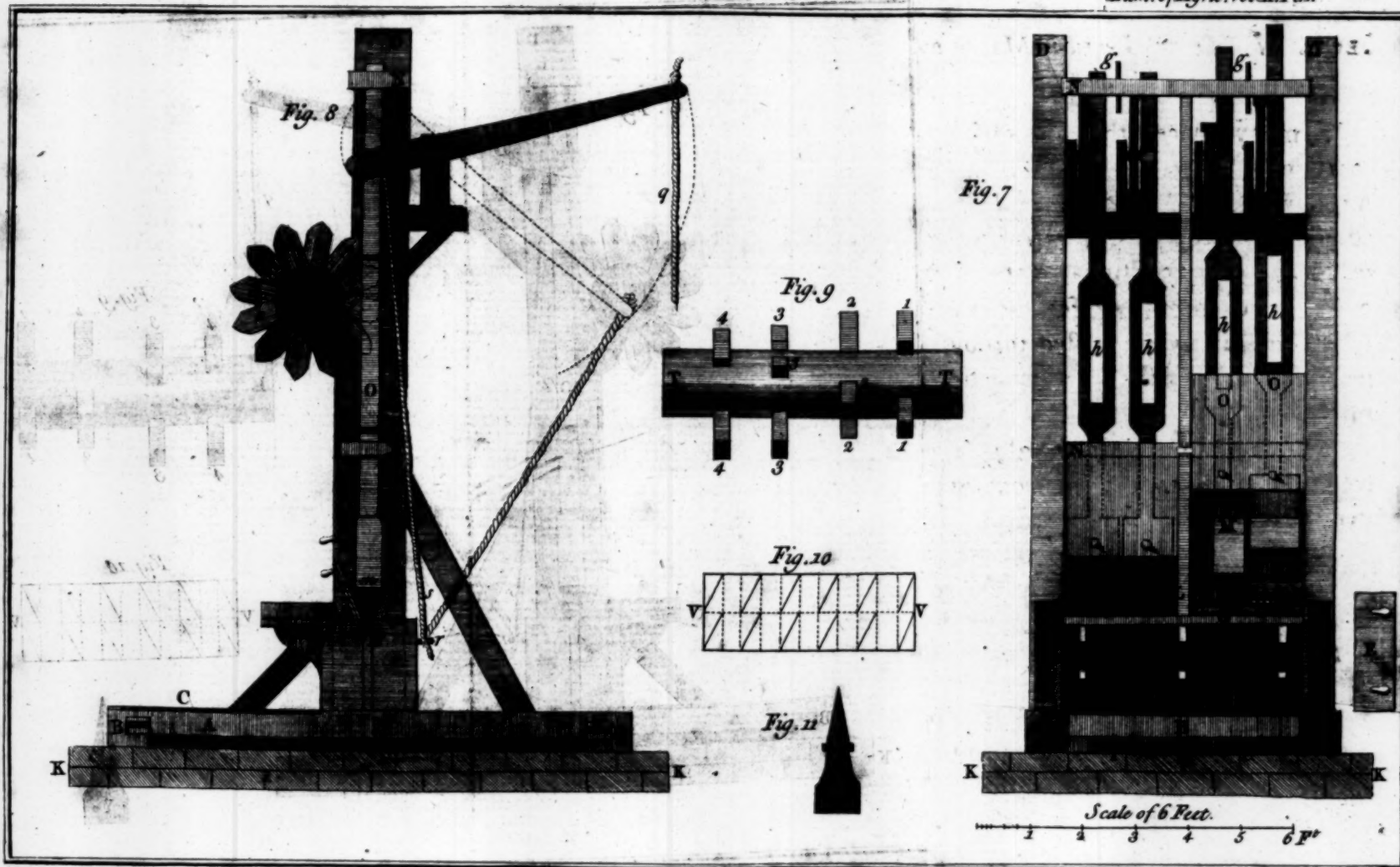
SECT. IV. *Of the Vertical Mill to pulverise Madder.*

In many places they pulverise madder-roots with a vertical mill; such as is used for olives, only much larger. It is turned either by water, or a horse. This mill, being in continual motion, requires one or two women to feed it with roots; which are afterwards passed through a fine sieve, and the siftings put again to the mill.

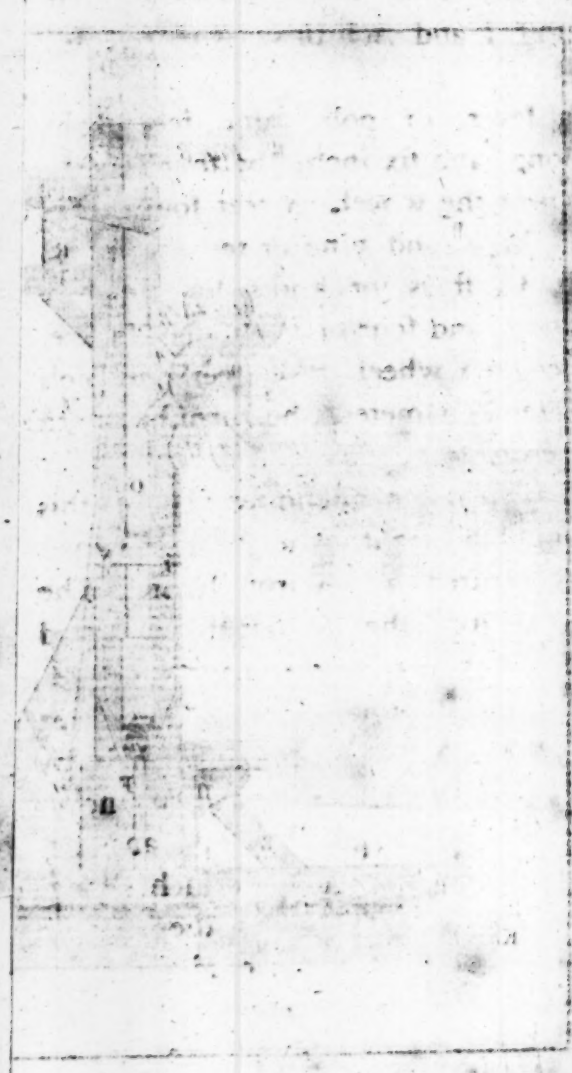
This mill would certainly serve very well to bruise the green roots, when the dyers use them in that state.

SECT. V. *Description of a Mill to pulverise Madder, as it is done at Lille, in Flanders.*

Figure 1, plate 9, shews the parts of a madder-mill: it is insulated, and covered only by a slight thatch. The figures 2, 3, 4, 5, and 6, are supplementary to the first: we must have recourse to them in our



J. Ellis sculp.



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our explanation of the parts of the mill : they are therefore distinguished by the same letters ; and each piece is represented apart.

A, a lever, or pole, nine feet eight inches long, and six inches by four large*.

B, axis of the wheel, six feet four inches six lines high, and nine or ten inches diameter. C, stays, or knees, four feet six inches long, and four or five inches square. D, the cogged wheel, three feet one inch six lines semi-diameter, and furnished with fifty-seven cogs.

The fellies, or circumference of this wheel, must be eight inches by four large : they are secured by an iron hoop. The traverses are six inches by four thick, pinned and keyed. The cogs are made of apple-tree wood, and project three inches three lines : they are two inches and a half by two at their insertion, and two inches and a half by one at the top ; and beneath the wheel they are two inches long, and one and a half square ; they act on the spindles of the trundle-head about one inch and a half of their length. The pins that fasten them are also apple-tree wood.

E, a

* A middle-sized horse works this mill with ease.

E, a beam twelve inches square. F, the trundle-head, thirteen inches semi-diameter; furnished with eighteen spindles, each a foot long, and two inches diameter: the ends of this trundle-head are two inches and a half thick, and hooped with iron. There also two iron bars pinned on to secure the joints of the wood.

G, another axle-tree, or turning-beam, eighteen feet six inches six lines long, ten inches square near the trundle-head, and fourteen inches diameter in its octagonal part. H, lifters four inches nine lines long, five inches broad, two inches and a half thick. It is apparent then that there are fifteen lifters inserted into the axle-tree to serve five beetles; that is, three to each. For this reason the lifters, the catches, and the pestles, are distinguished by the same figure: of this we shall say more hereafter.

K, flyers four feet five inches long, and four inches square: they are loaded with lead at their ends. L, catches which answer to the lifters, H: they project five inches nine lines, and are five inches broad, and two and a half thick.

M, other catches inserted into the sides or thickness of the beetles, N, and answer to the
the

the levers, Q. N, beetles ten feet four inches long, and four inches square. They are rounded at the end next the mortars, and shod with an iron foot four inches diameter, which may be seen in figure 6. The beetles are numbered in this manner, 1, 4, 2, 5, 3, (fig. 1.) to shew the order in which they play when the machine is in motion *. O, cross bars six inches by four, which support the joints, P.

P, joints eight inches long, six wide, and four thick. An iron pin keyed passes thro' each joint, and supports a moveable lever, Q, which acts on the catch, M, when the pestle, N, is to be kept up. Q, levers, two feet three inches six lines long, three inches thick by four wide.

R, keeps, six or eight inches wide, to prevent the beetles from being disordered. S, an upright post four inches square, in which the cross bars and keeps are inserted. T, mortars cut in a single piece of wood sixteen inches square: they are eleven inches deep, and their greatest diameter is seven inches:

* There are five beetles with the iron work: each should weigh about one hundred and twelve, or one hundred and twenty pounds: they are shod with an iron foot with cutting ridges at bottom.

inches : the bottom is lined with lead three or four lines thick *.

V, a trough to prevent waste, over which hangs a cloth fastened above to the keep, whilst the mill is at work.

X, a beam twelve inches square : this beam, and that at the other end, marked E, rest on the timber work that supports the roof. The sockets and pivots may be so well comprehended by the plate, that letters of reference were thought unnecessary : the sockets were brass, the pivots steel.

We have purposely omitted giving the dimensions of every part, to avoid confusion ; but the machine may be easily constructed by attending to the description we have given, which is very exact.

As soon as the madder comes out of the kiln, it is carried to the mill : when it is pulverised they pass it through a sieve, that it may be about as fine as saw-dust ; and it is immediately put up in casks, which must be kept in a dry place.

The

* Each mortar contains about six pounds of root. After a few strokes the root is taken out, to clear it of the refuse. It has been proved, that one of these mills, attended by a single man, will pulverise fifteen hundred pounds weight of madder in twenty-four hours.

The sieves used for madder are about two feet and a half diameter, and one foot high; they are made like cylindrical boxes of three parts: they are covered above and below with leather, to preserve the finer particles. The bottoms of the sieves are horse-hair, and they are finer or coarser according to the quality the madder is to be of. In some places I believe they use bolting instead of sifting.

The pulverised madder is distinguished into two kinds, bunch madder and loose madder: the bunch madder is the branch-madder, ground; the other is number O madder, ground; that is, madder from which the outer bark has been in part separated: this last is most valuable. To separate this bark they take the madder from the mill after it has received a few strokes: sifting it loosely takes away part of the bark: and it is then returned to the mill to be completely pulverised; yet great care must be taken that none of the part containing the dye is separated with the bark.

I procured models of these mills, to assist M. M. de Corbeil, who were inclined to erect one. M. de la Levrie, who was so good as to superintend the construction, soon per-

ceived the defects of the Lisle mill : he corrected them, and caused one to be built at Corbeil, which answered every purpose that could be expected from it. This gentleman was so kind as to give me the dimensions of the several parts of this mill, and to correct the drawings ; yet I thought it best to describe the Lisle mill as it is now in use : but I subjoin the plate of the Corbeil mill, which is certainly to be preferred.

SECT. VI. *Remarks on the Construction of the Lisle Mill.*

Of all mills, that of Lisle seems least proper for pulverising madder : it was first used for tobacco, and they turned it to another use without making the necessary improvements. 1. The beetles ten feet high cannot weigh one hundred and twelve pounds, as a foot of dry oak weighs only sixty pounds : the ten feet then, four inches square, weigh but sixty-six pounds two thirds ; and, if we allow ten pounds for the weight of the foot and the two catches, the whole will not weigh seventy-seven pounds : this is evidently too little to pulverise madder *.

2. The

* They loaded the beetles, it is true, with lead ; but it had better have been let alone.

2. The surface of the four inches square, reduced to a circle, as at the bottom of the beetles, is no more than twelve inches four sevenths : this makes not quite sixty-three inches for the surface or faces of the five pestles. 3. We may add, that the feet of the beetles, having teeth which are too short, are apt to clog, after which they have little effect. 4. It is easy to comprehend, by the proportion of the trundle-head to the cogged wheel, that each beetle can only make twenty-eight strokes and a half in a minute. 5. It is well known that a pound of madder, stamp'd close, occupies a space equal to a pint of water, which is supposed to be forty-eight cubic inches ; but it occupies a much greater space when it is in loose powder, as in the mortars: suppose then it only takes up half as much space again, it will be seventy-two cubic inches. They say that six pounds of the root are put at a time into each mortar, which would make four hundred and thirty-two cubic inches of matter in a round mortar eleven inches high, the greatest diameter of which is seven inches, the smallest at the bottom four inches and a quarter, and that of the aperture five inches ; and supposing the mortars to be full, what would

be the effect of the beetles? 6. The levers, which serve to raise the beetles and support them whilst the mortars are emptied, are badly contrived: they are very troublesome to be used; and the moment must be seized in which the lifters of the axletree have raised the beetle to its greatest height. 7. The flyers are superfluous, inconvenient, and even dangerous to the workmen: it is a useless load, that serves only to encrease the friction of the axletree on the pivots: besides, it can be of no use to make a motion regular and equal, except when it is fixed to an axis which turns very fast; and this is not the case, for the axletree turns only ten times in a minute. 8. We omit mentioning the inequality of the resistance, caused by the strait form of the lifters of the axletree, and the very considerable friction of the beetles within their keeps, occasioned by the length of the catches, because the power is capable of giving motion to a much greater weight than it is charged with; but this power being a horse, the strength of which is known, why should it not be applied to use? I think I have said enough to make the defect of the Lisle mill apparent: the comparison betwixt it and the Corbeil mill, which I shall

NOW

now describe, will point out other imperfections, on which it is needless to enlarge.

SECT. VII. *Description of the Madder-Mill
at Corbeil.*

There is no occasion to describe the wheel-work of this mill, being the same as that at Lisle: it will be enough to give the proportion of the parts which compose it. The pole, or lever, from the center of the axis of the cogged wheel, to the part where the links of the spring-tree bar are fastened, is nine feet long; the wheel is five feet semi-diameter, and has seventy-two cogs; the trundle-head is ten inches semi-diameter to the center of the spindles, and has twelve spindles; thus it makes six turns to one of the wheel. The horse, going three feet in a second, makes three rounds and a half in a minute, and the trundle-head twenty. The axletree having on its circumference three lifters to every beetle, each beetle makes sixty strokes in a minute, and the four two hundred and forty in the same space. The square part of the axletree, on which the trundle-head is fixed, is made out of a piece of wood five inches semi-diameter; the other

part of the axletree is larger, being seven inches semi-diameter. It is necessary it should be so large, that the tenons of the lifters may have a proper length and thickness: it is much better to be round than an octagon, or any other faced form, as the mortises may be more regularly made *. From the end of the lifters to the center of the axletree is twelve inches, so that in their motion they form a circle two feet diameter: the upper face of these lifters is cut in a curve, the radii of which are as tangents to the circumference of the abovementioned circle: the largest of these tangents is twelve inches, and determines the greatest rise of the beetles. By the lifters being thus curved the resistance is equal, at whatever height the beetles may be, as they are always in contact with the lifters at the same distance from their center of gravity. As there are on the length of the axletree twelve lifters in four parts, they form, one with the other, angles of thirty degrees, supposing them seen one behind the other, as if inserted on the same plane: on this account, when the first beetle is raised

* The pivots of this axletree should turn in brass sockets.

raised to half its height, the second is about to rise; the first quitting the lifter, the third is on the point of rising, &c. I say on the point, because we are to observe, that the lifters go under the catches, or under that which supplies their place, five or six lines; and that the greatest tangent of the curve, being twelve inches, is less, by near seven lines, than the sixth part of the circumference of the circle, and gives the first beetle time to quit the lifter before the third rises: this is necessary, that the power may never have more than two beetles to act upon.

The front of the frame-work is that side before which the axletree turns. The frame-work consists of two beams, ten feet long and eight inches square: betwixt them, at each end, is a traverse quarter, six inches by four. In the middle of the length and width of the beams rise two uprights, which are mortised and pinned: they are twelve feet eight inches high without their tenons, fourteen inches wide and six inches thick, supported by a brace mortised in the front at the height of two feet, at the back part four feet and a half. Betwixt these two uprights is the block on which the beetles

fall: it is made of a piece of dry tough elm, four feet and a half long betwixt the uprights, to which it is joined by a dovetail two inches thick, and as much deep: it is twenty inches high, and eighteen broad: it rests the whole breadth of its ends on the edge of the beams, and betwixt them on three pieces of wood, at equal distances, which lie on the brick-work which supports the whole. The block is divided crossways by a partition two inches thick, parallel with the uprights, and of the same breadth, fixed into the block by two tenons, and in a groove wide enough to receive its whole thickness, and the same above in the back part of the first keep, which is fixed: the upper end is in like manner fixed to the upper keep: this partition divides the block crossways into two troughs, each twenty-six inches long, formed by two sloping planks; so that the troughs are four inches and a half wide at the bottom within, eleven inches and a half at the top, and twelve inches perpendicularly high: and to prevent the loss of the light dust that rises in the work, the space betwixt the edge of the troughs and the first keep is boarded up; the boards at the back part, as well as the sides

of the troughs there, are fastened with grooves and dovetails into the uprights and partition; those before lift up in a groove like a sash, and are fastened by turnbuckles; the fronts of the troughs take entirely off; the pulverised root is taken out with a wooden spoon, and a feather broom, and they let it fall on a shelf before, which has a ledge four inches high; the fronts of the troughs are then put on again; they are filled with branch madder, the sliding shutters are pulled down, and the pestles are set at liberty to work, which had before been stopped whilst the troughs were emptied; this takes but little time doing; and the mill continues going during the time they gather up the root, and bolt it or sift it. There are two keeps, which serve to direct the beetles: the under part of the first is three feet, and the under part of the second ten feet, above the block; they are three inches and a half thick; the first is made level in the front with the back of the groove, that the sliding shutters may rest on it when they are closed, and slide over it when they are raised. Each keep consists of two parts; those at the back are let into the uprights, and pinned to them, and strongly fastened to the partition;

tition ; those in the front are made to take down and put up, as occasion serves : they slide in the grooves of the uprights, and those that run along the middle of the partition : they have besides two pins, by which they are kept in their places. The beetles are at the lower part twelve inches wide, eighteen inches high, and four inches thick ; so that their face or bottom contains forty-eight square inches : the upper part or stock of each pestle is eight feet and a half long, four inches wide, and three thick ; so that in the whole they are ten feet long, without comprising the cutters, which are four inches long, and formed like a carpenters chissel : the blades of them are two inches and a half wide, and the tongues three inches and a half long : there are seventeen to each beetle. There are no catches, because the lifters being in contact with their extremity always at the same distance, five inches from the center of gravity of the beetles, the resistance occasioned by the friction of the stocks in the keeps would have been very considerable. To avoid this inconvenience, a mortise twenty-five inches long, and three inches wide, was made in the face of the stocks of the pestles,

tles, strengthened on the sides by cheeks two inches thick. The upper parts of these mortises are six feet above the block; that is, on a level with the center of the axletree: this part is lined with a plate of copper strongly screwed, well polished and rounded at the edge to facilitate the fall of the beetles. On the side of the beetle-stocks, sixteen inches below the upper keep, are fixed catches a full inch thick, two inches high, and projecting four inches, to keep the beetles up whilst the troughs are emptying. The levers which serve for this purpose are placed behind, and rest on shoulders fixed on a piece of wood, which bears by its two ends on two brackets mortised and pinned into the two uprights, and supported by braces: these pieces are six inches square. The levers are made of quarter stuff, six inches and a half square, as well as the lifters of the axletree. The upper face of the shortest arm of the lever is rounded like the lifters, in a curve described by the original circle, the radius of which is the space from the middle of the catch to the center of motion of the lever, which should be parallel to the bottom of the catch. The radius of this circle, as well as the greatest of the curve, should

should be fifteen inches, that the beetle, being raised thirteen or fourteen inches, may not slip off. That the levers may be the stronger, the wood must not be cross grained; and in the center of motion it should be traversed by a square iron bar, projecting two inches on each side: these projections, being rounded into pivots, rest on the shoulders in notches which are lined, but better in brass sockets. A cord is fastened to the shortest arm, and the end of it is fastened occasionally to wooden pins at the back of the block, to keep the levers somewhat lower than the catches whilst the beetles are at work. The longest arm lessens by degrees towards the end till it is reduced to a square: at this part is fixed another cord, which is fastened to the same wooden pins when the beetles are to be kept up.

Remarks.

The beetles of this mill weigh only one hundred pounds with their mounting; perhaps a few pounds more, which may be abstracted by taking off a few inches of the lower part: there are never more than two beetles raised at a time, and one hundred
and

and thirty-three pounds and a half for the power to act upon. A middle-sized horse is generally reckoned able to apply one hundred and eighty pounds of his strength to move a machine, working for four hours together, and going one thousand eight hundred toises in an hour : he often goes faster, but so was this mill calculated : there remain then forty-six pounds and two thirds for the friction, which is more than it amounts to in this machine : we may even venture to assert, that the friction of it is less than in any other mill of the kind. A horse may bear this work the better, as every five or six minutes there are two or three minutes respite to empty the troughs, and give them a fresh supply. This mill at Corbeil never pulverised above two hundred pounds of roots a day, because that was all the kiln could supply it with ; but the time in which this work was done, induces us to think it could easily pulverise four hundred and eighty, or five hundred pounds. They say that the Lisle mill can pulverise five hundred pounds in twenty hours : we can scarcely believe it, especially as we imagine it does not work in the night : thus we must suppose it really works only ten hours, like that

that at Corbeil. Be it as it may, the work of these mills should be calculated by the weight of their beetles, the number of blows they strike in a minute, and the superficies of their bases; that is, the Corbeil mill is, to that of Lille, as four hundred pounds, the weight of the four beetles, multiplied by two hundred and forty, the number of blows they strike in a minute, and the product by one hundred and ninety-two, the superficies of the bases of the four beetles, is to three hundred and eighty-five, the weight of the five beetles, multiplied by one hundred forty-two and a half, the number of blows they strike in a minute, and the product by sixty-three, the superficies of the bases of the five beetles; or, after the numbers are reduced, as sixteen is to three; by which it appears, that if the Corbeil mill pulverises five hundred pounds in twelve hours, that of Lille should pulverise no more than one hundred.

The indifference they discover in Flanders, with respect to the situation of the kilns and mills, is worthy of blame; they are, it is said, in separate buildings, which have no communication: nothing can be more inconvenient. It is well known at
Corbeil,

Corbeil, that the root, which they some time ago pulverised in a little hand-mill, fixed in a barn, five or six toises from the kiln, which had no influence to warm it, grew damp, and clogged under the cutters, by which it was much damaged. This work is always done in winter, and it is scarcely possible it should be otherwise: the fogs must therefore be guarded against.

The kiln I have recommended would contain four thousand pounds weight of green madder, which would yield five hundred pounds of dry root when it had been there forty-eight hours: the mill can pulverise this quantity in a day. If one had a very considerable crop, for instance, four hundred thousand pounds, which would yield fifty thousand pounds of dry root, (and this is as much as the mill could turn out in the four winter-months, working every day) it would be necessary to have two kilns. The buildings to contain the kilns and mill might be disposed nearly in the following manner. A building should be erected sixty-three feet long, and twenty-one wide, with a floor twenty or twenty-two feet from the ground, which should be a store-room for part of the green root:
the

the under part should be occupied by the mill and its frame-work, so that at each end there would be a space of eighteen feet to the walls at the extremities: in the middle of this space the apertures of the furnaces to heat the stoves should be made, which should be so situated, that the floors of the kilns should be on a level with that of the store-room: trap-doors might be contrived in the floor of the store-room, to throw the dried roots down; and as they ought to be kept dry till they go to the mill, they may be heaped round the furnaces under the reversed pyramids of kilns; for they should be kept dry till they are barrelled up.

On a supposition that the produce of four hundred thousand pounds might be pulverised in the four winter-months, some place should be provided to keep it in proper order till the last went to the kiln: it must be spread at most two feet thick, that it may every day be turned. Experience convinces us, that eight cubic feet of green root weigh one hundred pounds. The surface of the granary will give one thousand three hundred and twenty-three square feet, which, divided by four, give
three

three hundred and thirty quintals and a quarter, or thirty-three thousand seventy-five pounds; but this does not come near four hundred thousand pounds. It is presumed, the best way would be to erect some large buildings, four or five stories high, which might altogether contain, at least, twelve times as much as the store-room above mentioned; but this expence might be saved, if the root could be taken up in small quantities during the autumn, winter, and part of the spring.

Explanation of the Figures of the Corbeil Mill.

Figure 7, plate 10, is the frame-work of the mill seen in the front: figure 8. is the same frame-work seen endways, the upright and beam being taken off.

A, beams, eight inches square, seen endways, fig. 7. and the length of one of them, which is ten feet, fig. 8.

B, traverse quarters, which are fixed into the beams: the length of one of them is seen, fig. 7. and the ends of both are seen, fig. 8. they are six inches by four.

C, a

C, a flooring or stage, laid on the grooved edge of the beams, and the traverse quarter.

D, uprights, fixed to the beams: their thickness may be seen, fig. 7. the top of one of the uprights only is perceivable (fig. 8), over the upper keep, N; and the breadth of the bottom is distinguished by two pricked lines on the end of the block which covers it, as the remainder of it is concealed by the middle partition. These uprights are twelve feet eight inches high, six inches thick, fourteen inches broad, as high as the axletree, then reduced to ten inches.

E, braces, which keep the uprights steady on the beams: those in the front are mortised at the height of two feet; those behind, at four feet and a half: they are six inches by four.

F, the block, on which the beetles fall: it is made of elm, four feet and a half long betwixt the uprights, and twenty inches high by eighteen broad: it has at each end a dovetail two inches thick, and as much deep, which go into the grooves of the uprights.

G, a shelf, level with the upper part of the block, of the same length, twelve inches wide, two inches thick, with a ledge four inches high: it rests on a groove at the edge of the block, and on the brackets, H, fig. 7. and 8.

I, three pieces of wood, which support the block.

K, the brick-work, which is the foundation of the frame-work.

L, a partition, which divides the block into two parts: it reaches from the block to the upper keep; it is two inches thick, and the same breadth and shape as the up-rights; it has on the front, and two sides next the uprights, grooves which run up till it begins to narrow; there are other the like grooves in the uprights. This partition consists of two parts: the lower part is fixed in a groove of the block, and above, with a tenon, and is besides pinned to the back part of the first keep, which is fixed: the upper-part is tenoned into the upper part of the first keep, and under part of the second: they go into grooves that cross the whole breadth of the front parts of the keeps, which are moveable.

M, troughs, in which the roots are put: they are four inches and a half wide at bottom, eleven inches and a half at the top, and twelve deep perpendicularly: they consist of two boards sloping before and behind, fig. 8. the space betwixt their edges and the first keep is boarded up. In the front, d, are sliding shutters. The fronts of the troughs take off. At fig. 7. is seen one of the troughs open, and the sliding shutter pushed up: two of the beetles are visible, one quite, the other half raised.

N, keeps, three inches and a half thick: their breadth consists of two parts; those behind are entirely fixed to the uprights: they are seven inches broad, notched half the thickness of the stocks of the beetles, in the parts where they pass: the other two pieces take off at pleasure, and are notched in the same manner to give the beetles room to work: they have each of them two keys, or tongues, four inches broad, as much long, and one inch thick, which go into the mortises in the fixed part of the keep, betwixt the stocks of the two beetles belonging to each trough, where they are fastened by two large pins,

pins, g. They slide in the grooves of the uprights: the undermost is six inches broad, that the shutters may slide over it: the uppermost is four inches, consequently projects an inch: the edges are rounded off. The under part of the first keep is three feet above the block; the under part of the second, ten feet.

O, beetles, ten feet high: they are twelve inches broad at bottom to the height of eighteen inches, fig. 7. four inches thick, fig. 8. with a stock eight inches and a half long, and four inches broad by three thick. At an inch above the first keep, they are left seven inches broad, for thirty-seven or thirty-eight inches, to make room for a large mortise, h, twenty-five inches long, and three inches wide. The upper part of the mortise is lined with copper, the angle being rounded off. Sixteen inches beneath the second keep, there are, on the sides of the stocks, catches, i, two inches high, an inch thick, and projecting four inches. The bottoms of the beetles are secured with an iron band, m, one inch and a half broad, and four lines thick, and armed with seventeen cutters, n. The or-

der in which they are placed may be seen fig. 15. and the shape of them fig. 16.

P, a bracket, six inches square, with its brace both mortised and pinned into the upright, fig. 8. there is another on the other upright, not visible in figure 7.

Q, fig. 7. a piece, six inches square, fixed to the brackets. The end of it might have been seen in figure 8. but it was not pointed out, to avoid confusion.

R, shoulders, resting on and pinned to the piece Q, notched at o, to receive the levers, fig. 7. and also at p, fig. 8. to receive their pivots.

S, levers, which serve to raise the beetles, and keep them up, whilst the troughs are emptied: they rest on shoulders, R, where they play: they are made of a piece of even-grained wood six inches broad, and two inches and a half thick: the length of the shortest arm is fifteen inches; that of the longest, four times as much. The center of the pivot should be on a level with the under part of the catches. At the end of the long arm is fastened a cord, q, which is fixed to the pins, r, in the block, when the beetles are raised thirteen or fourteen inches. Another cord, s,
is

is fastened as near as possible to the end of the short arm, which is tied to the same pins, *r*, when the beetles are at work.

T, the turning axletree, seen endways, fig. 8. and in front, fig. 9. it is round, and fourteen inches diameter: it is furnished with twelve lifters, on four planes, so disposed, that when it is at work, the lifters answer the mortises, *h*, fig. 7. by which they raise the beetles, without touching the sides: they may all of them be seen in fig. 8. Those that are on the same plane are distinguished by the same figures, 1, 2, 3, 4, as well here, as in fig. 9. They are made out of pieces of wood, six inches broad, and two inches and a half thick: their tenons, *X*, fig. 8. are two inches and a half by two, and are as long as possible, without touching in the center of the axle-tree. From the center of the axle-tree, to the point of contact of the levers, with the mortises, *h*, is twelve inches: this point is five or six lines under the mortises. Great care must be taken that the tenons of the lifters be not made of cross-grained wood.

V, the base of a beetle, seen endways, to explain the manner of placing the cutters,

X 3

which

which are represented by black lines, as if only their edges were seen: the pricked lines mark the division of the superficies to arrange them.

Y, fig. 11. one of the cutters marked n, fig. 7. and 8. the height from the upper part of the shoulder to the edge, four inches; the tongue, three inches and a half; in its largest part, half an inch square; the shoulder, about eighteen lines diameter; the edges, twenty-seven lines broad; they should be steeled and short.

The figures 10. and 11, are drawn by a scale four times as large as the rest, that their parts might be better distinguished.

Conclusion.

After what has been said on the culture of madder, and on the construction of kilns and mills, there is room to hope, that every intelligent planter will be in a capacity of raising a plant, which cannot fail satisfying him for his expence and trouble; it is certainly a capital consideration, that madder does not impoverish the land, and that the culture, which this plant requires, puts the earth in a state of bearing every kind of grain in abundance;

we

we shall make this evident, by the relation of a few experiments.

In the districts now in question the lands bear one year rye, or bear; the next, barley, or oats; and the third, lie fallow. In the same space of three years, a crop of madder, and one of corn, may be had. Having sown, one year, some bear, on a field which had borne madder, the seed being harrowed in remained six weeks in the ground, on account of the dryness of the weather; and at the end of that time but little came up; yet at harvest-time there were in this field as many sheaves as in others of the country; but the straw was six feet long, instead of four, and the ears were as long again as those of the other fields.

Another year, having sown some summer-wheat on land which had been in madder, there were, at harvest, twenty dozen sheaves on an arpent, whilst the other fields yielded only eight or nine. Lastly, another year, having sown oats on a madder-ground, it produced forty dozen sheaves an arpent, each dozen yielding five bushels (French): the common lands that year produced only five or six dozen. Thus

have we reason to expect considerable advantages from the culture of madder.

1. A reasonable profit by the sale of the root.

2. A considerable improvement to our lands.

3. The satisfaction of giving employment, and of course a means of living, to so many women and children.

By M. d'Ambournay's method, the advantage will be more considerable, as the kiln may be dispensed with, either by taking up the roots, at a time in which they may be dried in the sun, or by using them green.

AGRICULTURE. 313

BOOK XII.

Reflexions on Agriculture.

I Have asserted, that the improvement of Agriculture depends on the assiduity and industry of its followers: in all I have yet said, this has been my object. But I added, that Agriculture was in itself so important, as to claim a right of imploring the assistance of magistrates: this remains for me to treat of.

I attempt not to dictate any regulations, as it is not my place so to do: yet, I think, I cannot be taxed with imprudence, if I attempt to make known to the magistrates entrusted with the government of the kingdom, the grievances of our good husbandmen: if they are not reasonable, they will meet with no regard; but, if they are just, I hope such as have the legislative power in their hands will find some mild and proper means of redress.

SECT.

SECT. I. *Of the Inconvenience of binding
Sheaves with Wyths.*

In Beauffe, Gatinois, and other provinces, where they have plenty of wheat, the farmers sow in good land some fields of rye, intended for no other use but to make bands for their sheaves. In harvest-time they beat out the corn against the belly of a cask, and select the longest straw: after having soaked the straw some hours in water, they take it by a handful at a time, and separating the handful, tie the ears together in a double knot: this makes bands, consisting of two lengths of the straw. This method is very good. In years when the rye has failed, I have seen bands made with wheat-straw.

In other provinces they bind the sheaves with the straw of the corn they are cutting, twisting the ears together, after having divided the handful in two parts: they lay these bands on the ground, and bind the sheaves, which are larger or smaller, according to the length of the straw. The chief defect in this method is, that the sheaves are not so well bound, as when the
bands

bands of rye-straw are prepared in the house.

In 1709, as the ryes and wheats were killed by the frost, the farmers were obliged to bind their barley with lengths of cord: this was no great expence; for, after having carried in the sheaves, they unbound them in the barn, and carried back the cords to bind other sheaves.

In a great part of Burgundy, Champagne, and other provinces, they have a custom of binding their sheaves with wyths, which damages the woods greatly: were the farmers to cut for these wyths only lateral shoots, the hurt would not be very considerable; but they are not so attentive; and as these lateral shoots, not being so strong, are more apt to break, and besides are not so strait as the main shoots, the farmers generally choose the straitest and most thriving, which is very prejudicial to the woods, particularly as they usually cut much more than they have occasion for. What is really surprising is, that this bad custom is established in provinces which have plenty of vines, and where consequently osiers, or other kinds of wood proper for hoops and props, are well

well worth preserving. It is much to be wished this custom of cutting wyths were prohibited under severe penalties, and that the Beauffe manner of binding was introduced into these provinces.

SECT. II. *Land being divided into too small Plots in some Provinces, is a great Obstacle to the Progress of Agriculture.*

It has often with great reason been said, that making artificial pastures is the surest way of encreasing the produce of the land: but how are these pastures to be made in provinces where the land is so divided and subdivided among the inhabitants, that most of the pieces are but a few perches wide? In this case as much time is taken up in turning the plow, and carrying it from spot to spot, as in plowing. This is a great inconvenience; but it is a much greater, that all the proprietors are obliged to till their land in the same manner. If, for any particular reason, a husbandman was to sow one of these little fields with corn, or lay it in artificial pasture, his neighbours fields being open to the cattle, his small spot must
infallibly

infallibly be laid waste; and his industry be of little use to him: so that he is obliged to follow the old track, and servilely do as his neighbours have long done.

The English, sensible of these inconveniences, have enforced exchanges, referring the adjusting and settling them to commissioners appointed for the purpose. This method, whatever appearance of compulsion it may have, was of great service in England; but it appears to me to be impracticable in some parts of France: for instance, in the Upper Gatinois, where all the houses in the same parish are assembled together in a kind of hamlet, the lands in the neighbourhood of the houses become so valuable, that were the owners to be deprived of them, they must be greatly injured, let them give in exchange as much as they would at a greater distance. Besides, every land-owner is fond of his own, and has certainly a right to complain if it is taken from him. And indeed who can answer for the commissioners, that they have either knowledge or integrity enough, properly to execute their commission? This matter merits the attention of the government; and it is doubtless much easier

for them, than for me, to point out the measures proper to be taken in this case. Upon the whole, it seems to me most advisable, to leave the owners of the land at liberty to make exchanges, and to give constant encouragement to such as do so.

SECT. III. *The Common-Field Land and Right of Commonage are in some Provinces an invincible Obstacle to the Progress of Agriculture.*

In our provinces there is no such thing as common-field land; every one does as he pleases with his land: they sow various kinds of grain, pulse, and grafs for artificial pastures; or else they plant it in saffron: and they are well satisfied, that, without enclosure of hedge or ditch, their crops will not be damaged. If saintfoin, lucerne, or clover, has been sown with oats, as the young plant does not rot with the stubble, the owner need only distinguish his land by a few whisps of straw; and the shepherds and herdsmen will hinder their cattle from going on it: besides, the owners of the cattle are answerable for any damage they do: in
other

other respects the land is left at liberty for the cattle, wherever it is no damage to the owner. This custom seems to be founded on the law of nature, by which every man should enjoy his own property.

In the provinces where the right of commonage is established, all the fields without distinction are open to the cattle after harvest. As soon as the corn is carried off the land, any one may send in cattle till seed-time. In consequence of this liberty, the peasants destroy every thing that is then in the fields, so that there is no possibility of having vetches or late peas for fodder, and much less artificial grasses: in fact, every thing that is not got off with the corn becomes the prey of the cattle.

In some places, where the right of commonage is established, they are prohibited from breaking fences; every one may enclose his land; and what he encloses is exempt from this right: but in other parts the herdsmen pretend they have a right to drive their cattle into any enclosure. For this reason a husbandman or land-owner can grow nothing scarcely but corn, unless it is in walled ground, or near his house. The
herdsmen

herdsmen and shepherds are in some places so untractable, that in many districts they cannot be hindered from driving their flocks on the green wheat.

Under pretence that a right of commonage gives them a free entry into all land, the lower sort of people, who in general should only turn their cattle into the roads and on the waste, suffer them to stray into the fields that are in corn. On the other hand, when a field has been either plowed or sowed, the shepherds drive their flocks on them to pick up the roots of the plants, which the plow has thrown up: whence it follows, that if the land is ever so little wet, by the trampling of the sheep it becomes as hard as if it had not been at all plowed.

When part of a flock belongs to the shepherd, it is indeed very difficult to keep them from the green corn. The hogs and cows do considerable damage; yet the magistrates of the places are so accustomed to this pretended right, that they seldom interfere.

One would scarcely imagine that customs so barbarous, and so opposite to the progress

gress of Agriculture, should be in some sort authorised by prescription, and even encouraged, or at least winked at, by the magistrates: the fact is however certain; and the partisans of this custom have confidence enough to assert, that it is absolutely necessary for the encouragement of the encrease of cattle. What a strange error is this! can we possibly think that the means of encreasing the number of our cattle can consist in what deprives us of the opportunities of procuring for them a sufficiency of food? Experience has often convinced us, that two arpents of good lucerne will maintain four oxen, or as many cows, for six months in the year, with a very small addition of ordinary fodder: how many arpents of stubble would the same number of cattle require to maintain them? Cows and oxen would be in bad case had they no other feed but what the stubbles afford. This custom, far from favouring the encrease of cattle, is a real obstacle to it: this is so evident, that I think it quite unnecessary to prove it. In fact, the farms we have in Beauvais have no natural pastures; yet with the help of saintfoin the farmers in those

VOL. II. Y districts,

districts, who have flocks of three or four hundred sheep, twelve or fifteen cows, and seven horses, find means to maintain them, without consuming any thing that could otherwise turn to account: even the peasants can keep a cow or two without injuring their neighbours. It necessarily follows then, that the best method of encreasing our flocks and herds, and of course our manures and crops, is to abolish this same right of commonage. However, as it has in certain provinces been established time immemorial, as it is even authorised by local customs, it appears to me, that the only method of giving any life to Agriculture in those provinces would be to empower every proprietor to exempt from this custom a thirtieth part of his land: this would be only three arpents for a farm that employed three plows, reckoning thirty arpents for a plow: this reserve, being surrounded with a little ditch, or a dry or green hedge, should be sacred; and the owners of the cattle trespassing on it should be answerable for damages: and as the land that has been some time laid down in artificial grasses is very proper for bearing corn,

the

the proprietor should have power at any time to change the spot of reserve.

If the principal magistrates, who reside in provinces where this right of commonage is claimed, have as good an opinion as we have of the advantages that would result from the above regulation, there is no doubt but it would soon be established; and such, particularly merit punishment who drive their flocks on the green corn, unless it is the owner of the land, who finding his wheat too rank may think it necessary to feed it down.

SECT. IV. *In some Cases long Leases would tend to the Improvement of Agriculture.*

I have already mentioned the advantages that have resulted from some of my ancestors granting to peasants long leases of part of our estate. Many may at this time be possessed of waste and incultivated land, such as ours then was; either because it is full of stones, which it would be very expensive to carry off; or it may perhaps be wet, and the draining it come to too much money: in either case the alienation of them would be an advantage. The owners of

these lands are often unwilling, for many good reasons, to alienate them entirely; but that the farmers might be able to repay themselves the expence of improving such land, they would probably be willing to let long leases of them, for instance, twenty-seven years, if such leases were not in France deemed real alienations, and consequently loaded with such heavy duties to the lessee as no farmer will subject himself to. Were these long leases generally allowed, I am sensible they might be abused; yet I think I have made it evident, that a farmer who has only a nine years lease will never undertake, for so short a term, to improve the land he holds. Our magistrates should therefore find some means of softening the rigour of the law, and encourage long leases, in every case where no great inconvenience could ensue.

SECT. V. *Reflections on the Regulations respecting Corn.*

The inhabitants of great towns, knowing little of the true causes of dearths, think bread can never be too cheap: they are

pleased at a wet harvest, as they imagine the corn will not keep: and when they hear that insects devour the corn in the granaries, they hope from day to day that the price will be lowered, as the farmers must be obliged to bring it to market. But they do not consider that the ruin of the farmers would soon occasion the land to lie uncultivated, and of course corn becoming scarcer would bear a higher price. They little consider that the farmer is of course discouraged, if, instead of receiving a reasonable recompence for his trouble and expences, he sees his stock by degrees reduced to nothing. This is the fatal effect of plentiful harvests; the low price of corn will not pay the farmer the expences of his Husbandry. I could prove, by very exact calculations, that the farmers who hold the best lands do not at this time make, either from the sale of their corn, the produce of their flocks, which fetch but a small price, or from their hogs, poultry, &c. wherewithal to pay their rent, taxes, &c. and defray their charges: these farmers suffer, but they hope for better days. It is quite otherwise with the farmers who hold lands

of an indifferent quality; for, as the expences of tillage sometimes are more than in good soils, and as poor lands require more seed than rich, and yield much smaller crops, they are of course ruined: some of these farmers have already been obliged to let their lands lie uncultivated. Thus, instead of cultivating the wastes, a thing much to be wished for, and which would give plenty to the kingdom, we shall in a little time see the quantity of uncultivated land greatly increased, and the general amount of the crops much lessened. Plenty of corn will thus be the ruin of the farmers, and this ruin will be immediately followed by a diminution of the crops, and consequently a general dearth when the harvests are not good.

When corn has been several years cheap, many vines are planted: several remedies have been offered for this inconvenience, but the most certain way of lessening the number of vineyards, is to keep corn up to a good price.

I shall not any longer dwell on truths that are so self-evident to all who have had opportunities of observing the frequent variations

variations in the price of corn: the principal view of the government should be to find the means of enabling the farmer to get a comfortable livelihood, without injuring the manufacturers and artisans by letting corn bear too high a price.

To make Agriculture flourish, the price of corn should never be less than the farmers expences.

To prevent the poor from suffering, bread should never be at too high price. These are the two objects of a good administration.

Perhaps the best method of bringing about the second object, would be to give all attention to the first; as by encreasing the quantity of tilled land, the crops would of course encrease, and this is the true method of preventing dearths; for the encrease in the price of any commodity will be but trifling, and of no long continuance, whilst there is no scarcity of it.

Yet I think we must not give absolutely all our attention to this first object, which consists in raising the price of grain: in fact, if this was the only point aimed at, it would only be necessary to open the

ports for exportation : this would doubtless raise the price, but perhaps more than enough. For this reason this method, which is in itself good, should not be put in practice without particular restrictions.

I am far from being an enemy to the exportation of corn ; on the contrary, I think it often useful, and sometimes necessary. But from what I have read of the revolutions in the price of corn, I find that the licences for exporting it have almost always been succeeded by dearths ; and this is not difficult to account for.

Whenever it was found that the farmer could not reimburse himself for his charges, and pay his taxes, the exportation of corn was permitted : this raised the price ; but, if the succeeding crop fell off ever so little, a dearth ensued. The laying up corn in France is prohibited. Thus by the means of exportation the French magazines are formed out of the kingdom, and France is soon obliged to buy at a high price, of strangers, that corn which they had before sold them at a low rate. These are well-known facts, and need no proof. What has once happened may happen again.

Wheat

Wheat is at this time very plentiful and cheap: if things continue in this state, and the exportation of it is allowed, the kingdom will be drained of corn, and the first time the crop falls short there will be a dearth. It will then perhaps be said, that it were best to prohibit for ever the exportation of corn. I am far from being of this opinion; but I think that before it is suffered to be exported, instead of hindering magazines of corn from being formed in the kingdom, they should be authorised and encouraged. It is certainly more advantageous to have magazines in the kingdom, than without, among strangers.

Public magazines might do very well in small states that are governed like a single family, but could never be established in a great kingdom, and this for many reasons. The best way is to let every man lay up his corn; and for that purpose the regulations made in years of dearth should be abolished: whilst they are in force, petty officers have it in their power to be tyrannical and arbitrary, by making inconsiderate applications of them.

It must certainly be allowed, that there is no way of providing against dearths, but
by

by laying up corn in plentiful years; yet every obstacle is laid in the way of it, and any one that lays up corn he did not grow is subject to heavy taxations.

The land-owners and farmers, who are allowed to keep their corn only three years, are generally too much in want of money not to sell it almost as soon as it is got in; and others, who could afford to lay out ten, twelve, or fifteen thousand livres, are prohibited from forming magazines: what resource is there in a time of dearth? The exportation of corn is permitted for the benefit of the farmer; and strangers are allowed to form magazines of it when the inhabitants are forbid it. Nothing can be more contrary to sound policy; yet this is the present law: these regulations were doubtless necessary at the time they were made, but the execution of them should have been limited to the occasions that gave rise to them.

As these striking truths cannot be controverted, the advocates for these regulations content themselves with saying, that they are not rigorously enforced when corn is plentiful: if this is the case, it is probably because it would not be proper so to do;

and for this reason it is necessary to abolish them, not only because a good citizen will always respect what is law, but also because there are many examples of their having been very injudiciously enforced by petty and inferior officers.

Besides, to take away the odium that is now annexed to laying up corn, it is necessary it should be authorised by a law, without which it can never be effectually done,

I may be deceived, but it appears to me, that the proper regulations in this matter would be, 1. To promote the sale of corn in the internal parts of the kingdom, that one part of the inhabitants may without constraint supply the wants of the other, 2. To permit every one to form magazines, and lay up their corn till years of dearth. 3. When the granaries are known to be full, if the harvests continue plentiful, an exportation of corn might be allowed without hurt to the kingdom, not by licences to particular persons, but by a general liberty granted, that the profit resulting from it might flow in a partial channel.

If in some plentiful years the prohibition of laying up corn has been attended with injury

injury to the kingdom, in making a law for allowing it, the contrary extreme should be carefully avoided. We ought never to forget the poor; but it is unnecessary for me to enlarge on this subject, as our magistrates are well inclined to protect them, which they may easily do without injuring others,

ELUCIDATIONS *of several Parts of*
this Work, together with some
ADDITIONS.

VOLUME I.

1. **I**N Book I. Chap. VII. in treating of the quality of lands, I forgot to observe that they always partake of their original quality : I meant, that though a poor soil may, by dint of manuring and tillage, bear good crops, yet they no sooner leave off mending it, but it relapses into its first state of poverty. In like manner a good strong soil may, for want of manures and good tillage, cease bearing large crops : but when ever it is well mended and plowed, it soon resumes its former good quality : it is equally the same with light and heavy lands.

2. Book II. To what is said relative to plowing add, that every good husbandman should, if possible, plow in broad lands, laying the middle of the stitch high, and making the trench deep to carry off the water : by this means an encrease of surface will be gained,

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In lands that are very wet, or very shallow, beds may successfully be made five feet wide, separated by intervals of three feet, which are to be dug deep, and the earth thrown on the beds. By this method these beds will be thoroughly drained, and they will have a depth of soil which before they had not.

Most farmers, with a view of keeping the feed for their flocks, leave their lands as long they can without plowing. They would find it more for their advantage to turn their fallows before the winter, maintaining their sheep with artificial grasses.

I have observed that digging is the best method of tillage, but that it is too expensive. However, I know a person who follows this method, and who assured me that a piece of land, which costs him ten pence (French) digging, yields him twice as much as it would have done if it had been plowed.

3. I have remarked in Chapter II. that in plowing certain sorts of land too deep, several crops would be lost. This is indeed true: but we must observe, that though the under stratum of earth, when turned up by the
the

the plow, hurts in the first instance the crop of wheat, yet after a time it amends and fertilises the land. When a depth of soil is to be given to a field, it should be plowed deep when oats are to be sown, as they do very well on it; and the tillage the field gets in the year of fallow, and the manure that is laid on it, prepares it very well for wheat.

4. In Chapter III. I have said that lime may be mixed with dung. We must add, that a good manure may be procured, by forming a heap, of a layer of turf, and of a layer of lime, and so alternately: if there should, at the end of a year or fifteen months, be amongst it any heath, furze, or broom, it must be gathered up and burnt.

A husbandman who lived in a province where salt is a merchandize, made an excellent manure of it by a mixture in layers, with earth, dung, and lime.

I observed in the same Chapter, that the cakes left after making oil from colseed, flax, hemp, &c. yield good manure, which indeed they do; but they are generally reserved for feeding cattle.

I omitted to observe, in treating of manures and tillage, that a field, which is in good order

order in these two respects, bears heat and drowth better than such as are badly cultivated.

I should observe, that in treating of sheep-folds I only formed an hypothesis; for a farm that consists of only ninety arpents of land cannot maintain a flock of three hundred sheep, unless there are extensive sheep-walks in the neighbourhood.

5. I shall add to what I have said in Chapter IV. where the working of land is treated of, that I earnestly recommend to husbandmen, 1. To be careful to sow their lands with such grain only as best suits it; because it is more profitable, for instance, to have a large crop of rye than a small one of wheat: 2. Not to sow all their land that is to be in corn with wheat: it is much better to bestow good tillage to the best land, to prepare it properly for wheat, than to give three plowings to poor lands, that will only make twofold returns when they are in wheat: it is much more adviseable to reserve these for crops that require less tillage.

6. In Chapter V. I have remarked, that the points of the ears sometimes freeze in April: I should have added that this accident

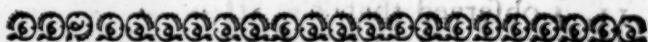
dent happens also in May; and that rye is more subject to it than wheat.

7. I have said in Chapter VI. where I treated of sowing (Sect. IV. and V.) that much seed might be saved by using a drill, particularly in good soils: but I did not say enough on this subject. The seed sown in this manner is that most to be depended on; it is in no danger, either from hail or frost. Lands cultivated in the common way, and which require ten or eleven bushels (French) of seed, generally yield forty: by the help of the drill five bushels (French) is sufficient: this is an eighth part saved, which becomes a matter of consequence when wheat is worth twenty livres the *septier* in seed-time, and sells only for fourteen or fifteen livres after harvest; and this is almost always the case when high-prized seed is sown.

8. In Book III. wherein the distempers of corn are treated of, I remarked that it was no great blemish for wheat to be glazed: I should have said that this accident does it no damage, and that on the contrary glazed corn yields a great deal of flour; that this flour requires much water, and makes very good bread. The bakers are well acquainted

with this ; but they keep it a secret from the farmers of whom they buy their corn.

9. It is not, I think, improper to observe, relative to what I have said of lucerne in Book VI. that the second and third mowings of this grass seldom yield more hay than the first alone.



VOLUME II.

10. **I**N Book VII. Chap. II. I mentioned only two drills. Before I spoke of a third drill intended to sow single rows, I waited till the weather would permit our trying it. I have been at a loss to know which to prefer amongst several instruments of this kind, and particularly those of M. l'Abbe Soumille, and of M. de Maurpas, a careful lover of agriculture in Picardy, because I have not been able to try them. I am yet obliged to wait till M. Delu has made some experiments on his land. However I was present at an experiment made at Châtillon près Sceaux by M. Trudaine, M. de Montigny his son, together with M. M. the baron Ogilvi Camus, Vaucanson, Delu and several

several others. In this trial four drills of different construction were compared. The tongue-drill was universally preferred. The cylinder-drill had some faults objected to it, which however I think might be easily remedied. I intend to try to make a cultivator that will stir the earth betwixt the rows of wheat sown in the common way.

11. I observed that the straw of naked barley is not fit food for cattle. It is however proper to mention that it is good for cows.

In treating of lucerne I say I have had twenty thousand weight of dry hay on an arpent, &c. It is to be observed, that this lucerne was weighed whilst in the field, before it was carried into the barn; for as this hay must not be too much dried for fear of losing the leaves, it will of course lose part of its weight when it has been some time housed.

I have sometimes specified the particular quantity of seed proper to be sown on an arpent, but it must be understood that the seed must be always perfectly good. However, as the seed seldom all comes up, more seed is generally sown than I mention.

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12. To Sect. VII. where horse-beans are treated of, add that in Provence they give horse-beans alone to their horses; but as those of our provinces are not accustomed to such food, there would be danger of giving them disorders, if they had more than a tenth part in a feed of oats.

13. I have but one remark more to make on the subject of Book IX. which is that the surest means of having green fodder in winter for the cattle is, 1. To keep the aftermath of some old pieces of lucerne, intended to be broke up, for feed for the cattle in the beginning of winter. 2. To have a piece of good land sown with furze: the tender branches of them are cut off, and after breaking the prickles, in the manner we have directed, they are given to the cattle. 3. To sow the large winter-cabbage. 4. When these articles are consumed, the cattle may be fed with roots; as navews, carrots, turnips, potatoes, &c. 5. Lastly, a plant which M. Delatour d'Aigues has brought to my remembrance, and which merits cultivation: it is the marygold, *caltha*. Its leaves continue green all the winter; and the cattle are very fond of it. The seed might be saved, and being sown the latter end of the

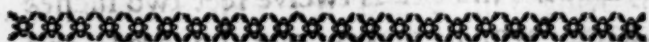
the summer, the leaves, &c. might be reserved to be used in the winter.

14. It is proper to add to what I have said on the subject of madder, (Book II. Chap. IV.) that M. de Laussat-d'Etignac having observed, that the *Rubia Tinctorum* grew in the hedges in his neighbourhood, he caused half an arpent of it to be planted in single rows in the month of May 1760: he treated it like maiz with respect to its culture; and in October following he caused the roots to be taken up, which were about the size of a goose-quill: he was in hopes of drying it by the sun and wind; but the weather proving rainy, and the sun having little power, the root was damaged. He told me his embarrassment: I recommended it to him, if he had any dyers in his neighbourhood, to follow M. d'Ambournay's method, and let them use the green root. In consequence of this advice M. de Laussat caused some to be taken up and carried to a dyer, who had so much success in using it, that his dyes far exceeded those made with Dutch madder.

This experiment comes very *à-propos* in support of those made by M. d'Ambournay, which I have already related. It is a con-

firmation that, if a dyer has ever so little knowledge in his business, he may make a great advantage of the green root; and if this discovery is no benefit to the dyers, it is their own fault.

Whenever a larger quantity of roots are taken up than can be immediately made use of, they may be preserved in M. d'Am-bournay's method, by laying them in a trench, and covering them with a thick layer of earth. By this means a dyer may keep, either in his cellar or his garden, a good quantity of green madder, to be used as he has occasion for it.



*Of the different Measures of Land mentioned
in this Work,*

1. **T**HE small *arpent* in use about *Paris* is one hundred square perches; the perch is eighteen royal feet: this arpent contains thirty-two thousand four hundred royal feet.

2. The middling *arpent* in use in *L'Isle de France* is one hundred square perches, of twenty royal feet: it contains forty thousand royal feet.

3. The

3. The great *arpent*, called the royal measure, is one hundred perches, each perch twenty-two royal feet; it contains forty-eight thousand square feet.

4. The *acre*, in one part of *Normandy*, is one hundred and sixty square perches: each perch twenty-two royal feet, which makes seventy-seven thousand four hundred and forty square feet.

5. The *journal* about *Bordeaux*, which contains eight hundred and eighty-eight square *toises*, is divided into three *pougnérées*; the *pougnérée* is seventy-two *escas*: it contains ten thousand six hundred and fifty-six square royal feet: the *esca* is twelve feet two inches square, which makes one hundred and forty-eight square feet.

6. The *journal* in the neighbourhood of *Saint-Dizier* in *Champagne* contains eighty-eight square perches; each perch twenty-two royal feet.

7. The *septerée* of *Clermont-Ferrand* contains eight hundred square *toises*.

The *journal* of *Lorraine* is two hundred and fifty square *toises*; the *toise* being ten feet *Lorraine*, equal to eight feet nine inches ten lines royal.

A G R I C U L T U R E

3. The Great square, called the Royal
 Palace, is one hundred paces
 each side, two royal feet is contained
 in each side.

4. The area in one part of the square
 is one hundred and forty square paces;
 each perch twenty-two royal feet; which
 makes twenty-eight thousand four hundred
 and forty square feet.

5. The square about the palace, which
 contains eight hundred and eighty-eight
 square paces, is divided into three parts;
 the largest is about the palace, and
 contains eight hundred and eighty-eight
 square paces; the other two are
 square, which each contains
 four hundred and forty square paces.



6. The square in the neighbourhood of
 the palace, which contains eighty-
 eight square paces; each perch twenty-
 two royal feet.

7. The square of the Palace, which
 contains eight hundred square paces;
 The square of the Palace is two hundred
 and eighty square paces; the side being
 one hundred and forty royal feet nine inches
 and three lines royal.

